Proceedings of Sinn und Bedeutung 23

Volume 1

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FOREWORD

Presentation

We are happy to present the Proceedings of Sinn und Bedeutung 23, which was held at the Universitat Autònoma de Barcelona (UAB) on September 5-7, 2018.

The conference received 241 submissions, out of which 52 talks, 18 posters, 6 alternates were accepted. As there was one cancellation, one of these alternates was eventually presented as a talk, and the other 5 were presented as posters.

The 4 invited talks were given by Berit Gehrke, in the area of formal semantics and the syntax/semantics interface; Wolfram Hinzen, on the topic of representation of meaning in special populations with language disorders; Beth Levin, in the area of Lexical Semantics; and Judith Tonhauser, in the area of the prosody-meaning interface and information structure.

We would like to acknowledge several funding sources, without which the conference could not have been held: the Spanish network on Meaning and Grammar (FFI2016-81750-REDT); the Faculty of Arts, the Department of Catalan Philology, and the Faculty of Translation and Interpretation of the UAB; and the Deptartment of Translation and Language Sciences of Universitat Pompeu Fabra). We also acknowledge the ICREA Foundation, whose funds have supported the edition of these Proceedings. We specially acknowledge Cristina Real-Puigdollers for taking care of this edition.

Bellaterra, May 2019

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VOLUME 2

Contradiction-free strengthening and alternative discharge: The case of Farsi *-i* indefinites.[1]

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Abstract. Existential Free Choice Items (EFCIs) differ from each other both within and across languages with respect to a number of parameters (Alonso-Ovalle and Menéndez-Benito, 2015; Chierchia, 2013). Our understanding of the possible variation within this class of items is rather limited, however, because the sample of EFCIs that have been studied in depth is also quite narrow. This paper contributes new data. We zoom in on a variety of indefinites in Farsi (Indo-Iranian), which we call *-i* indefinites (*i*-INDs for short), that share some core properties of EFCIs. The paper has two main goals. It discusses (a) where *i*-INDs fit crosslinguistically, and (b) how they fit within the type of alternative-based theory of EFCIs developed in Chierchia (2013). With respect to (a), the paper shows that *i*-INDs pattern with other EFCIs in modal and downward entailing contexts, but, surprisingly, with ordinary indefinites in unembedded contexts. With respect to (b), the paper shows that the behavior of *i*-INDs is predicted by an alternative-based theory if, as a last resort strategy, some EFCIs allow for the deactivation of some of the alternatives that they invoke, under the threat of deriving a contradiction.

Keywords: Free Choice Items, Exhaustification, Indefinites, Farsi.

1. Introduction

Existential Free Choice Items (EFCIs) are quantificational DPs that have existential force. They contrast with ordinary indefinites in that, when interpreted under the scope of a modal, they yield interpretations that are stronger than those that ordinary indefinites give rise to. To illustrate, consider the pair of German sentences in (1), from Kratzer and Shimoyama (2002), which feature the ordinary indefinite *ein* and its EFCI counterpart *irgendein*.

(1) a. Mary muss einen Arzt heiraten.
Mary has-to EINEN doctor marry
'Mary has to marry a doctor.' (Kratzer and Shimoyama, 2002: p. 13)
b. Mary muss irgendeinen Arzt heiraten.
Mary has-to IRGENDEIN doctor marry
'Mary has to marry a doctor—any doctor.' (Kratzer and Shimoyama, 2002: p. 13)

With *ein* or *irgendein* scoping under the deontic necessity modal, both (1a) and (1b) convey that in all worlds compatible with what Mary is permitted to do, she marries a doctor, but while (1a) is compatible with Mary not being allowed to marry some doctors, (1b) requires that Mary be

[1]Thanks to the anonymous reviewers for *Sinn und Bedeutung 23*, and to the audiences at that conference and at the 11th Toronto-Montréal-Ottawa Workshop in Semantics. For sharing the work with us, and for useful comments, we are grateful to Amir Ahmad Anvari, Amy Rose Deal and Anahita Farudi, Masoud Jasbi, and Raj Singh. The Social Sciences and Humanities Research Council of Canada provided financial support through Insight Grants *Modality in the Nominal Domain* (435-2013-0103) and *Modality across Categories: Modal Indefinites and the Projection of Possibilities* (435-2018-0524) (Alonso-Ovalle, Principal Investigator), which is gratefully acknowledged here. The names of the authors are listed in alphabetical order. As usual, all mistakes are our own.

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permitted to marry *any* doctor. This requirement, which is usually referred to in the literature as a 'free choice effect' (FCE), teases (1b) apart from (1a) (Kratzer and Shimoyama, 2002).

EFCIs have received a considerable amount of attention in the literature (see Alonso-Ovalle and Menéndez-Benito, 2015 for an overview). By now we know, for instance, that these items differ from each other both within and across languages with respect to a number of parameters (Alonso-Ovalle and Menéndez-Benito, 2015; Chierchia, 2013). Yet, our understanding of the possible crosslinguistic variation within this class of items remains limited because the size of the sample of studied EFCIs is also quite limited.

This paper contributes new data. We zoom in on a variety of indefinites in Farsi (Indo-Iranian), which we will call *-i* indefinites (*i*-INDs for short), that share some core properties of EFCIs. The paper has two main goals. It discusses (a) where *i*-INDs fit crosslinguistically, and (b) how they fit within the type of alternative-based theory of EFCIs developed in Chierchia (2013). The main claims of the paper are the following: i) with respect to (a), we show that *i*-INDs pattern with other EFCIs in modal and downward entailing contexts, but, surprisingly, with ordinary indefinites in unembedded contexts; ii) with respect to (b), we discuss how their behavior is predicted by an alternative-based theory if, as a last resort strategy, some EFCIs allow for the deactivation of some of the alternatives that they invoke under the threat of deriving a contradiction.

The paper is structured as follows: Section 2 reviews some of the parameters of variation among EFCIs that have been presented in the literature and shows how *i*-INDs position themselves in the space of possible variation; Section 3 reviews the basics of the type of alternative-based theory of EFCIs presented in Chierchia (2013), which captures the pattern of interpretation of *i*-INDs in modal and DE contexts, where they behave like other EFCIs; Section 4 focuses on the interpretation of *i*-INDs in unembedded contexts, where they depart from other EFCIs, and, to conclude, Section 5 summarizes the discussion.

2. Situating *i*-INDs

We start by providing in Section 2.1 a review of some of the parameters of variation that EFCIs are known to be sensitive to. Section 2.2 describes the behavior of *i*-INDs with respect to the properties discussed in Section 2.1. As mentioned above, *i*-INDs pattern with other EFCIs in modal and downward entailing contexts, but depart from them when unembedded. Section 2.3 summarizes the discussion.

2.1. Some parameters of variation

EFCIs can be selective with respect to the type of modals under which they can be embedded. The example in (1b) shows that *irgendein* can be interpreted under the scope of a modal that receives a deontic interpretation, and (2) that it can also be interpreted under the scope of a modal that receives an epistemic interpretation (Kratzer and Shimoyama, 2002). Spanish *algún*, another EFCI, patterns with *irgendein* in that it can be interpreted under both deontic and epistemic modals as well (Alonso-Ovalle and Menéndez-Benito, 2010).

(2) Juan muss in irgendeinem Zimmer im Haus sein.
Juan must in IRGENDEINEM room in-the house be
'Juan must be in a room of the house.' (Aloni and Port, 2015: p. 120)

Not all EFCIs are equally flexible, though. EFCIs differ with respect to the type of modals that they tolerate. Romanian *vreun*, for instance, has been described as being grammatical only under epistemic modals (Fălăuş, 2014), as the contrast between (3a) and (3b) (where the modals are assumed to have a deontic interpretation) illustrates.

(3) a. (Din câte ştiu,) Maria {trebuie / poate} să fie cu vreun coleg.
from what know-1.SG Maria {must / may} SUBJ be-3.SG with VREUN colleague
'(As far as I know,) Maria must/may be with a colleague.' (Fălăuş, 2015: p. 68)

b. *Trebuie/ *Pot să pregătesc vreun curs până mâine.
must may SUBJ prepare-1.SG VREUN course by tomorrow
'I must/may prepare a course by tomorrow.' (Fălăuş, 2015: p. 68)

EFCIs not only differ with respect to which type of modals they allow for, they also differ with respect to the interpretations that they trigger when embedded under modals. As we have seen, some EFCIs, like *irgendein*, trigger a FCE—they convey that *each* individual in the extension of the NP instantiates the existential claim in some accessible world. Other EFCIs, like *algún*, convey a weaker interpretation in modal contexts: they simply require that there be more than one individual in the extension of the NP that instantiates the existential claim in some accessible world—a 'modal variation' effect (MVE)(von Fintel, 2000). For instance, when *algún* is interpreted under the modal, the sentence in (4) requires more than one doctor to be a permitted option, but is compatible with María not being permitted to marry some doctors.

(4) María tiene que casarse con algún médico.
María has to marry with ALGÚN doctor
'Mary has to marry some doctor or other.'
(Alonso-Ovalle and Menéndez-Benito, 2015: p. 10)

Some EFCIs, like *irgendein* or Italian *un qualche* (Aloni and Port, 2015; Chierchia, 2013), have been described as conveying a FCE in combination with deontic modals and a weaker MVE in combination with epistemic modals.

EFCIs also differ with respect to their behavior in downward entailing (DE) contexts. While some, like *irgendein*, are interpreted as plain existentials in these environments, as seen in (5a), others, like Italian *un NP qualsiasi*, are deviant in these contexts, as (5b) shows.

(5) a. Niemand hat irgendeine Frage beantwortet.
Nobody has IRGENDEINE question answered
'Nobody answered any question.' (Aloni and Port, 2015: p. 121)

b. *Non tutti ragazzi hanno letto un libro qualsiasi.
Not all boys had read UN book QUALSIASI (Chierchia, 2013: p. 260)

We find differences between EFCIs when they are unembedded, too. Some, like *irgendein* and *algún*, are felicitous, but convey a modal meaning component. The sentence in (6), for instance, conveys that the speaker does not know which doctor María married.

(6) María se casó con algún médico.
María se married with ALGÚN doctor
'María married some doctor or other—the speaker doesn't know who.'
(Alonso-Ovalle and Menéndez-Benito, 2015: p. 2)

In contrast, other EFCIs, like Romanian *vreun*, are ungrammatical when unembedded (Fălăuş, 2014), as seen in (7).

(7) *Monica s-a întâlnit cu vreun prieten.
Monica REFL-have.3SG met with VREUN friend.MASC
'Monica met a friend.' (Fălăuş, 2014: p. 122)

Those EFCIs that express a modal component when unembedded differ from each other with respect to the type of modality that they convey. While some, like *algún*, express epistemic modality, others, like *un NP cualquiera*, express agent indifference, as (8) illustrates.

(8) Juan compró un libro cualquiera.
Juan bought UN book CUALQUIERA
≈ 'Juan grabbed a book at random.' (Alonso-Ovalle and Menéndez-Benito, 2018: p. 2)

In sum, EFCIs differ with respect to their behavior in modal environments, DE environments, and when they are unembedded. In modal environments, EFCIs differ with respect to the type of restrictions (if any) that they impose on the modals under which they can be embedded, and also with respect to the interpretation that they convey: some require all individuals in the extension of the NP to be possibilities (a FCE), but others only some (a MVE). In DE environments, some EFCIs are grammatical, but others are not. The same is true when EFCIs are unembedded. We have also seen that those EFCIs that are grammatical when unembedded express a modal component, and that there are differences with respect to the type of modality that they convey. How do *i*-INDs behave with respect to the properties described above? We turn to this issue next.

2.2. *i*-Indefinites

In Farsi, DPs of different sizes have existential force. Bare NPs, which are taken to denote number neutral properties (Deal and Farudi, 2007; Modarresi and Simonenko, 2007), have existential force, as (9) shows.

(9) Leili sib xarid.
Leili apple bought-3.SG
'Leili bought an apple/apples.' (Krifka and Modarresi, 2016: p. 875)

In (10), by adding *ye(k)* ('one') to a bare NP, we get what we will call a '*ye(k)* indefinite', and in (11), by adding the suffix *-i*, what we will call a 'bare *i*-IND.' Adding both *ye(k)* and *-i* to a bare NP, as in (12), yields what we will call a '*ye(k) i*-IND.'[2] These three types of DPs also have existential force.

[2] *Yek* is realized as *ye* in the informal register.

(10) Ye ketāb xarid-am.
one book bought-1.SG
'I bought a book.'

(11) Ketāb-i xarid-am.
book-IND bought-1.SG
'I bought a book.' (Modarresi and Simonenko, 2007: p. 181)

(12) Ye ketāb-i xarid-am.
one book-IND bought-1.SG
'I bought a book.'

We will zoom in here on the effect of the suffix *-i* by looking closely at the interpretation and distribution of bare *i*-INDs and *ye(k) i*-INDs, with a focus on the latter.

2.2.1. *i*-INDs in DE environments

We start with the behavior of *i*-INDs in DE environments. Unlike Italian *un NP qualsiasi*, but like Spanish *algún* or German *irgendein*, *i*-INDs are felicitous in these environments, where they seem to contribute plain existential quantification, as the translations of (13a) and (13b) illustrate.

(13) a. Shak dār-am Forood (ye) film-i dide bāsh-e.
doubt have-1.SG Forood (one) film-IND seen be-3.SG
'I doubt that Forood has watched any movies.' doubt $>\exists$

b. Age Ava (ye) ketāb-i bexun-e, ye jaize migir-e.
if Ava (one) book-IND read-3.SG one gift take-3.SG
'If Ava reads a book, she gets a gift.' if $[\ldots\exists\ldots]$, then ...

There is an exception for *ye(k) i*-INDs. Unlike bare *i*-INDS, but like *algún* and *irgendein*, *ye(k) i*-INDs resist embedding under sentential negation, as (14) illustrates.

(14) Forood ye ketāb-i na-xarid.
Forood one book-IND NEG-bought-3.SG
'Forood did not buy some book.' $*\neg>\exists$

We turn now to the behavior of *i*-INDs in modal contexts.

2.2.2. *i*-INDs in modal environments

i-INDs are felicitous under the scope of modals. Unlike *vreun*, and like *algún* or *irgendein*, they do not impose restrictions on the type of modals that they allow for. They are fine under modals that receive a deontic interpretation, as in (15a), with a possibility modal, or in (15b), with a necessity modal.

(15) a. Forood mitun-e (ye) ketāb-i bexar-e.
Forood can-3.SG (one) book-IND buy-3.SG
'Forood can buy any book.'

b. Forood bāyad (ye) ketāb-i bexar-e.
Forood must (one) book-IND buy-3.SG
'Forood must buy a book and he can buy any book.'

i-INDs are also grammatical under modals that receive an epistemic interpretation, as in (16a), with a possibility modal, or in (16b), with a necessity modal.

(16) a. Forood momken-e (ye) ketāb-i xarid-e bāsh-e.
Forood possible-be (one) book-IND bought-3.SG be-3.SG
'Forood might have bought a book.'
b. Forood bāyad (ye) ketāb-i xarid-e bāsh-e.
Forood must (one) book-IND bought-3.SG be-3.SG
'Forood must have bought a book.'

Under deontic modals, *i*-INDs contrast with *ye(k)* indefinites in that they convey a FCE, like *irgendein*, but unlike *algún*. We can see that with the help of the scenario in (17). While the sentence in (18), with a *ye(k) NP* indefinite, is true in that scenario, its counterpart with an *i*-IND (the sentence in (15a), repeated in (19) below) is false.

(17) There are only five books ($\{b_1 \ldots b_5\}$). Forood is allowed to buy b_1, he is allowed to buy b_2, and he is also allowed to buy b_3, but he is not allowed to buy b_4 or b_5.

(18) Forood mitun-e ye ketāb bexar-e.
Forood can-3.SG one book buy-3.SG
'Forood can buy a book.' $\Diamond > \exists$ TRUE

(19) Forood mitun-e (ye) ketāb-i bexar-e.
Forood can-3.SG (one) book-IND buy-3.SG
'Forood can buy any book.' FALSE

If the *i*-IND in (19) were interpreted as contributing an existential under the scope of the possibility modal, the sentence in (19) would be true in the scenario in (17), like (18) is. Since (19) is false, we see that in this context *i*-INDs yield interpretations that are stronger than those expected of an existential scoping under a modal: (19) requires all books to be permitted options. The deviance of the discourse in (20) highlights this.

(20) Forood mitun-e (ye) ketāb-i bexar-e, (# ammā ne-mitun-e ketāb-e b_1 o
Forood can-3.SG (one) book-IND buy-3.SG, (but NEG-can-3.SG book-EZ b_1 ACC
bexar-e)
buy-3.SG)
'Forood can buy any book, but he cannot buy b_1.'

When embedded under deontic necessity modals, *i*-INDs convey a FCE as well. To illustrate this, consider the scenario in (21). While the sentence in (22) with a *ye(k) NP* indefinite is a felicitous description of the scenario in (21), its counterpart with an *i*-IND, in (23), is false, because not all books are permissible options for Forood. The sentence in (23) conveys that Forood is required to buy a book and that any book is a permissible option for him.

(21) There are only five books ($\{b_1 \ldots b_5\}$). Forood is required to buy a book and he is allowed to buy b_1, b_2, or b_3, but he is not allowed to buy b_4 or b_5.

(22) Forood bāyad ye ketāb bexar-e.
Forood must one book buy-3.SG
'Forood must buy a book.' $\Box > \exists$ TRUE

(23) Forood bāyad (ye) ketāb-i bexar-e.
Forood must (one) book-IND buy-3.SG
'Forood must buy a book and he can buy any book.' FALSE

i-INDs are also felicitous with epistemic modals, necessity and possibility alike. However, under epistemic modals, *i*-INDs do not require all individuals in the extension of the NP to be possibilities. For instance: the sentence in (25) can describe the scenario in (24). In other words, in combination with epistemic modals, *i*-INDs convey a MVE effect, rather than a FCE. In this, *i*-INDs pattern with other EFCIs, like *irgendein* or Italian *un qualche* (Aloni and Port, 2015; Chierchia, 2013), as mentioned in the previous section.

(24) Assume there are only five books ($\{b_1 \ldots b_5\}$). The speaker is convinced that Forood has bought a book, but knows that he hasn't bought b_4 or b_5.

(25) Forood bāyad (ye) ketāb-i xarid-e bāsh-e.
Forood must (one) book-IND bought-3.SG be-3.SG
'Forood must have bought a book.'

In DE and modal contexts, *i*-INDs behave like other EFCIs, then. The situation is different when *i*-INDs are not embedded.

2.2.3. Unembedded *i*-INDs

Like *algún* or *irgendein*, but unlike *vreun*, *ye(k) i*-INDs are grammatical, as seen in (26a). However, the status of unembedded bare *i*-INDs depends on register. Farsi has two registers: formal and informal. In the formal register, unembedded bare *i*-INDs are grammatical. In the informal register, there is speaker variation: they are ungrammatical for some (Jasbi, 2016), but grammatical for others, as illustrated in (26b).

(26) a. Forood dirooz ye ketāb-i xarid.
Forood yesterday one book-IND bought-3.SG
'Forood bought a book yesterday.'
b. Sara ro be pesar-i moarefi kard-am.
sara ACC to boy-IND introduce did-1SG
'I introduced Sara to a boy.' (Hosseini Fatemi, 2013: p. 7)

In contrast with other EFCIs that are grammatical in unembedded contexts, unembedded *ye(k) i*-INDs and bare *i*-INDs (when accepted) have no detectable modal component. Quite clearly, they do not express agent indifference. The sentence in (27a), for instance, can be an appropriate description of the scenario in (27b).

(27) a. Forood dirooz (ye) ketāb-i xarid.
Forood yesterday (one) book-IND bought-3.SG
'Forood bought a book yesterday.'

b. *Scenario:* Forood wanted to buy *The Iliad* and did so. He wouldn't have bought any other book.

Unembedded *i*-INDs have no detectable epistemic component, either. The application of the battery of tests used in the literature to detect this modal component shows that this is the case. For instance, unlike *algún*, *i*-INDs are compatible with *namely* continuations that specify the individual that instantiates the existential claim, as the discourse in (28) shows.

(28) Forood dirooz (ye) ketāb-i xarid be esm-e Iliad.
Forood yesterday (one) book-IND bought-3.SG to name-EZ Iliad
'Forood bought a book yesterday, namely *The Iliad*.'

Likewise, unlike what is the case with *algún*, the dialogue in (29), where the addressee asks the speaker about the identity of the witness of the existential claim, is not deviant:

(29) A: Forood dirooz (ye) ketāb-i xarid.
Forood yesterday (one) book-IND bought-3.SG
'Forood bought a book yesterday.'
B: Which one?

Along the same lines, Aloni and Port (2015) show that asking 'guess who?' after a sentence containing *irgendein*, as in (30), is deviant. In contrast, the counterpart with an *i*-IND is perfectly fine, as (31) illustrates.

(30) Irgendein student hat angerufen.# Rat mal wer?
some student has called Guess PRT who?
'# Some student called. Guess who?' (Aloni and Port, 2015: p. 119)

(31) Forood dirooz (ye) ketāb-i xarid. Hads bezan chi?
Forood yesterday (one) book-IND bought-3.SG guess hit what
'Forood bought a book yesterday. Guess which?'

Finally, Chierchia (2013) shows that discourses like (32), where the individual satisfying the existential claim is previously mentioned, are deviant with epistemic indefinites, as in (32a). As (32b) illustrates, they are fine with *i*-INDs .

(32) a. John hat geschummelt. #Deshalb ist irgendein Student aus deiner Klasse ein Betrueger.
John has cheated. Therefore is IRGENDEIN student from your class a cheater
'John cheated. Therefore a student in your class is a cheater.'
(Chierchia, 2013: p. 251)

b. Forood ketāb-e Iliad-o xarid. Bana-bar-in Forood (ye) ketāb-i xarid-e
Forood book-EZ Iliad-ACC bought-3.SG therefore Forood (one) book-IND bought-3.SG
'Forood bought *The Iliad*. Therefore, Forood has bought a book.'

In view of the data above, we conclude that *i*-INDs have no detectable modal component when unembedded.

To finish this section, we note that unembedded *i*-INDs, unlike *algún*, convey uniqueness (that at most one individual satisfies the existential claim). This is shown in (33):

(33) Forood dirooz (ye) ketāb-i xarid, (# ye roman o ye ketāb-e
Forood yesterday (one) book-IND bought-3.SG, (one novel and one book-EZ
sher).
poetry)
'# Forood bought a book yesterday, a novel and a poetry book.'

The deviance of the 'how many' question in the discourse in (34) points in the same direction.

(34) A: Forood dirooz (ye) ketāb-i xarid.
Forood yesterday (one) book-IND bought-3.SG
'Forood bought a book yesterday.'
B: # How many?

2.3. Interim summary

Table 1 below summarizes the previous discussion and compares *i*-INDs with other EFCIs. We see that *i*-INDs show a distinctive property of EFCIs: in DE contexts, they behave like plain existentials, but in modal contexts, their interpretation is stronger than that of ordinary indefinites. *i*-INDs depart from other EFCIs in how they behave when unembedded: they are grammatical, but they do not convey modality. Like ordinary indefinites (and unlike some EFCIs, like *algún*), in unembedded contexts *i*-INDs convey uniqueness.

Taking as baseline the contribution of *i*-INDs in DE contexts, which shows that they are interpreted as existentials, we can conclude that the suffix *-i* triggers strengthening of a basic existential interpretation both in modal—where they trigger a FCE or a MVE—and in unembedded contexts—where they convey uniqueness. The strengthening of a basic existential interpretation in modal contexts is a distinctive property of EFCIs. We turn next to the issue of where *i*-INDs fit in a theory of EFCIs that relies on strengthening of a core existential interpretation, taking the implementation of Chierchia (2013) as basic framework.

contexts / EFCIs	*modal*		DE	*unembedded*
	epistemic	*deontic*		
irgendein	strengthened		$\exists x$	modality
algún	strengthened		$\exists x$	modality
vreun	strengthened	*	$\exists x$	*
un qualsiasi	strengthened		*	modality
i-INDs	strengthened		$\exists x$	no modality

Table 1: *i*-INDs compared to other EFCIs

3. EFCI behavior: *i*-INDs in modal and DE contexts

We start in Section 3.1 with a preview of the alternative-based theory of EFCIs presented in Chierchia (2013), which, as we will see in Section 3.2, suffices to capture the behavior of *i*-INDs in modal and DE contexts. This is unsurprising, since *i*-INDs pattern with other EFCIs in these environments. We will then turn in Section 4 to the behavior of *i*-INDs in unembedded contexts, where *i*-INDs depart from other EFCIs.

3.1. An alternative-based theory of EFCIs (Chierchia, 2013)

According to the theory of EFCIs presented in Chierchia (2013), EFCIs are existential quantifiers that introduce two types of semantic alternatives: scalar and strengthened ('pre-exhaustified') domain alternatives. To illustrate, under this analysis, the *i*-IND in (35a) is taken to be an existential quantifier: it denotes the set of properties that are true of at least one book in a given domain D.[3] Its domain alternatives, in (35b), are determined by (possibly) shrinking D. The scalar alternatives, in (35c), are determined by (possibly) shrinking D and considering stronger cardinality predicates (Chierchia, 2013: 252).

(35) a. $[\![\text{(ye) book-i}_{[+\sigma,+D]}(D)]\!]^g = \lambda P_{\langle e,st\rangle}.\lambda w.\exists x[\text{BOOK}_w(x) \wedge \text{ONE}(x) \wedge \mathbf{D}_w(x) \wedge P_w(x)]$

b. $[\![\text{(ye) book-i}_{[+\sigma,+D]}(D)]\!]^{g,\text{D-ALT}} =$
$\{\lambda P.\lambda w.\exists x[\text{BOOK}_w(x) \wedge \text{ONE}(x) \wedge D'_w(x) \wedge P_w(x)] \mid D'_w \subseteq \mathbf{D}_w\}$

c. $[\![\text{(ye) book-i}_{[+\sigma,+D]}(D)]\!]^{g,\sigma\text{-ALT}} =$
$\{\lambda P.\lambda w.\exists x[\text{BOOK}_w(x) \wedge \text{N}(x) \wedge D'_w(x) \wedge P_w(x)] \mid D'_w \subseteq \mathbf{D}_w \wedge \text{N} > \text{ONE}\}$

The alternatives in (35b) and (35c) turn propositional by combining with other expressions in the semantic derivation through pointwise functional application. For instance, assuming that the domain of quantification is the set of individuals $\{b_1, b_2\}$, the IP in (36a) expresses the proposition that Forood bought one of these two books ($b_1 \vee b_2$) and contributes the set of domain alternatives in (36c) and the set of scalar alternatives in (36e).[4] Each domain alternative p can be strengthened by conjoining it with the negation of as many other domain alternatives as consistency permits. The set containing these strengthened domain alternatives at the propositional level (the 'pre-exhaustified' domain alternatives) is given in (36d).

(36) a. LF: $[_{\text{IP}}$ Forood bought (ye) book-i$_{[+\sigma,+D]}$ $]$

b. $[\![[_{\text{IP}} \ldots \text{(ye) book-i}_{[+\sigma,+D]}]]\!] = \quad b_1 \vee b_2$

c. $[\![[_{\text{IP}} \ldots \text{(ye) book-i}_{[+\sigma,+D]}]]\!]^{\text{D-ALT}} = \quad \{b_1,\ b_2\}$

d. $[\![[_{\text{IP}} \ldots \text{(ye) book-i}_{[+\sigma,+D]}]]\!]^{\text{EXH-D-ALT}} = \quad \{b_1 \wedge \neg b_2,\ b_2 \wedge \neg b_1\}$

e. $[\![[_{\text{IP}} \ldots \text{(ye) book-i}_{[+\sigma,+D]}]]\!]^{\sigma\text{-ALT}} = \quad \{b_1 \wedge b_2\}$

These alternatives play a role in strengthening the assertion, via corresponding exhaustification operators (O_σ for ALT_σ, and $O_{\text{EXH-D}}$ for $\text{ALT}_{\text{EXH-D}}$). The strengthening operators O_σ and $O_{\text{EXH-D}}$ take

[3] $[\![\cdot]\!]^{g,\text{D-ALT}}$ and $[\![\cdot]\!]^{g,\sigma\text{-ALT}}$ are interpretation functions that map expressions to sets of semantic objects. For expository purposes, we use $[\![\cdot]\!]^{g,\text{EXH-D-ALT}}$ for the 'pre-exhaustified' domain alternatives. In (35a) we use a domain variable $D_{\langle s,et\rangle}$, an argument of the quantifier, for convenience. We take $\mathbf{D}_w$ to be the value of D at the evaluation world w, and $\text{ONE}(x)$ to convey that the cardinality of x is larger or equal to one. In (35c), N conveys that x has cardinality n or more, where n is larger than one. We freely switch from function to set talk.

[4] To make LFs more readable, we follow Chierchia (2013) in representing the quantifier *in situ*. In (36), 'b_n' stands for the proposition that Forood bought b_n. Note that the set of scalar alternatives should also include the contradiction ($\bot$), because functions like $\lambda w.\exists x[\text{B}_w(x) \wedge \text{N}(x) \wedge x \in \{b_1\} \wedge \text{BOUGHT}_w(F,x)$ (where n conveys that x has cardinality larger than 1) are in the set. Since the assertion is not contradictory, it does not entail $\bot$, and, so, the exhaustification operator (introduced below) will negate $\bot$. The effect of conjoining the assertion with the negation of $\bot$, the tautology ($\top$), is innocuous. For that reason, and to improve readability, we ignore $\bot$. We also ignore the assertion from the set of domain alternatives.

a propositional constituent ϕ, and strengthen $[\![\phi]\!]$ with the negation of all the alternatives to ϕ (of the relevant type) not entailed by $[\![\phi]\!]$:

(37) $[\![O_x[\phi]]\!] = \lambda w.[\![\phi]\!](w) \wedge \forall p \in [\![\phi]\!]^{x\text{-ALT}}[p(w) \rightarrow [\![\phi]\!] \subseteq p]$

The alternatives introduced by EFCIs have to be obligatorily used up by one of these operators. The $_{[+\sigma/+D]}$ subscript conveys that both the scalar and (strengthened) domain alternatives are 'active' and need to be 'discharged' by the corresponding strengthening operator.

3.2. *i*-INDs as EFCIs

The setup above is designed to derive the behavior of EFCIs. We have seen in Section 2 that *i*-INDs behave like other EFCIs in modal and DE contexts, and, therefore, if we just restrict our attention to these environments, this basic setup extends to them. Let's provide an illustration.

Under deontic modals, we have seen that *i*-INDs trigger a FCE, as the discourse in (20), repeated in (38) below, shows.

(38) Forood mitun-e (ye) ketāb-i bexar-e, (# ammā ne-mitun-e ketāb-e b_1 o bexar-e)
Forood can-3.SG (one) book-IND buy-3.SG, (but NEG-can-3.SG book-EZ b_1 ACC buy-3.SG)
'# Forood can buy any book, but he cannot buy b_1.'

Exhaustification derives the FCE. Consider the LF of the Farsi counterpart of (39a), presented in (39b). Assuming a domain containing two books ($\{b_1, b_2\}$), the IP conveys the proposition that Forood bought b_1 or b_2, in (40a), and contributes as scalar alternative the proposition that Forood bought both books, in (40b). Since the scalar alternative is stronger than (40a), O_σ strengthens (40a) by conjoining it with the negation of that alternative, as seen in (40c). The complement of $O_{\text{EXH-D}}$ expresses the proposition that is true in any world where Forood is allowed to buy only one of the books in the set $\{b_1, b_2\}$. The domain alternatives of the complement of $O_{\text{EXH-D}}$ are given in (40e), and the domain of pre-exhaustified domain alternatives in (40f). All propositions in (40f) are stronger than the proposition in (40d). $O_{\text{EXH-D}}$ yields the proposition that is true in a world *w* if and only if (40d) is true in *w* and all propositions in (40f) are false in *w*. The negation of the propositions in (40f) conveys that either Forood is permitted to buy b_1 and he is also permitted to buy b_2, or that he is not permitted to buy either book, as shown in (41). That, together with the proposition expressed by the argument of $O_{\text{EXH-D}}$ entails that Forood is permitted to buy either book, as (42) illustrates.

(39) a. Forood can buy (ye) book-i
b. LF: $O_{\text{EXH-D}} \Diamond\ O_\sigma[_{\text{IP}}$ Forood buy (ye) book-i$_{[+\sigma,+D]}]$

(40) a. $[\![[_{\text{IP}} \ldots \text{(ye) book-i}_{[+\sigma,+D]}]]\!] = \quad b_1 \vee b_2$
b. $[\![[_{\text{IP}} \ldots \text{(ye) book-i}_{[+\sigma,+D]}]]\!]^{\sigma\text{-ALT}} = \quad \{b_1 \wedge b_2\}$
c. $[\![O_\sigma[_{\text{IP}} \ldots \text{(ye) book -i}]]\!] = (b_1 \vee b_2) \wedge \neg(b_1 \wedge b_2) \Leftrightarrow \quad b_1 \veebar b_2$
d. $[\![\Diamond O_\sigma[_{\text{IP}} \ldots \text{(ye) book -i}]]\!] = \quad \Diamond(b_1 \veebar b_2)$
e. $[\![\Diamond O_\sigma[_{\text{IP}} \ldots \text{(ye) book -i}]]\!]^{\text{D-ALT}} = \quad \{\Diamond b_1, \Diamond b_2\}$
f. $[\![\Diamond O_\sigma[_{\text{IP}} \ldots \text{(ye) book -i}]]\!]^{\text{EXH-D-ALT}} = \quad \{\Diamond b_1 \wedge \neg\Diamond b_2, \Diamond b_2 \wedge \neg\Diamond b_1\}$

(41) a. $\neg(\Diamond b_1 \wedge \neg\Diamond b_2) \Leftrightarrow \neg\Diamond b_1 \vee \Diamond b_2 \Leftrightarrow \Diamond b_1 \rightarrow \Diamond b_2$
b. $\neg(\Diamond b_2 \wedge \neg\Diamond b_1) \Leftrightarrow \neg\Diamond b_2 \vee \Diamond b_1 \Leftrightarrow \Diamond b_2 \rightarrow \Diamond b_1$

(42) $[\![O_{\text{EXH-D}}\Diamond O_\sigma[_{\text{IP}}\ldots]]\!] =$ $\Diamond(b_1 \veebar b_2) \wedge (\Diamond b_1 \leftrightarrow \Diamond b_2)$

This setup derives the FCE of *i*-INDs in deontic contexts. We have seen that *i*-INDs convey a weaker modal component (a MVE) with epistemic modals. In the interest of space, we will ignore the contrast between these two types of modal contexts, and refer the reader to (Chierchia, 2013: chapter 5) for discussion of this issue.

Moving beyond these modal cases, we have seen that (object) *i*-INDs are interpreted as narrow scope existentials in DE environments, just like other EFCIs , as (13b), repeated in (43), shows.

(43) Age Ava (ye) ketāb-i bexun-e, ye jaize migir-e.
if Ava (one) book-IND read-3.SG one gift take-3.SG
'If Ava reads a book, she gets a gift.' if [... ∃ ...], then ...

Let's consider (43), with the LF in (44a). Assuming a domain containing two books ($\{b_1, b_2\}$), the IP in the LF in (44a) denotes the proposition in (44b). Its scalar alternative, in (44c), is entailed by (44b), so O_σ has no effect. The pre-exhaustified domain alternatives, in (44d), are inconsistent with (44b), and their negation ($(b_1 \rightarrow g) \leftrightarrow (b_2 \rightarrow g)$) entailed by it, so $O_{\text{EXH-D}}$ has no detectable effect, either. If, unlike Italian *uno qualsiasi*, *i*-INDs tolerate vacuous exhaustification, (44a) shows their true, not strengthened, nature.

(44) a. LF: $O_{\text{EXH-D}} O_\sigma$ [$_{\text{IP}}$ if Ava reads (ye) book-i$_{[+\sigma,+D]}$, she gets a gift]
b. $[\![[_{\text{IP}}\ldots]]\!] =$ $(b_1 \vee b_2) \rightarrow g$
c. $[\![[_{\text{IP}}\ldots]]\!]^{\sigma\text{-ALT}} =$ $(b_1 \wedge b_2) \rightarrow g$
d. $[\![O_\sigma[_{\text{IP}}\ldots]]\!]^{\text{EXH-D-ALT}} =$ $\{b_1 \rightarrow g \wedge \neg(b_2 \rightarrow g), b_2 \rightarrow g \wedge \neg(b_1 \rightarrow g)\}$

To sum-up: in modal and DE contexts, *i*-INDs don't really differ from other EFCIs, and the basic exhaustification approach to the behavior of EFCIs suffices to capture their behavior.

To our knowledge, the previous literature has not classified *i*-INDs as EFCIs. There are however hints about their status as EFCIs in previous work. For instance, Jasbi (2016) shows that bare *i*-INDs require the extension of their NP not to be a singleton. The example in (45), from Jasbi (2016), makes the point: the conditional in (45b) is deviant because the *i*-IND in its antecedent ranges over a singleton domain.

(45) a. *Scenario:* Mr. and Ms. Karimi have two daughters and a son. In this family, ...
b. #age pesar-i ezdevāj kon-e, pesar-e mojarad na-dār-im.
if boy-IND marry do-3.SG, boy-EZ single NEG-have-1.PL
'If a son marries, then we won't have any single son.' (Jasbi, 2016: p. 249)

If *i*-INDs are EFCIs, the antisingleton constraint should not come out as a surprise: if the extension of the NP were a singleton, there would be no proper domain alternatives, and domain exhaustification will always be vacuous.

Similarly, based on their behavior in DE contexts, Deal and Farudi (2007) hypothesized that *i*-INDs introduce domain alternatives (although they did not discuss the effect of these alternatives in modal contexts.)

There are then hints about the EFCIs status of *-i* INDs. But why only hints? The answer probably lies in their behavior in unembedded contexts. As we saw in Section 2, *i*-INDs behave like regular indefinites in unembedded contexts: they convey no modal component (but convey uniqueness). In the next section, we turn to the predictions of the alternative-based approach for the behavior of EFCIs in unembedded contexts.

4. Unembedded *i*-INDs

We start in Section 4.1 by laying out the predictions of the alternative-based approach with respect to the behavior of EFCIs in unembedded contexts. Sections 4.2 and 4.3 discuss these predictions with respect to the behavior of unembedded *i*-INDs and put forth the hypothesis that what teases *i*-INDs apart from other EFCIs is that they allow for partial exhaustification.

4.1. Unembedded EFCIs: the exhaustification approach and covert modality

To understand where unembedded *i*-INDs fit, let's look at the behavior of other unembedded EFCIs, together with the predictions of the exhaustification approach.

Under Chierchia's analysis, unembedded EFCIs are predicted to derive, by design, a pathological meaning. Consider, for instance, (46), and assume a domain containing two doctors: $\{d_1, d_2\}$. Since *irgendein*, by hypothesis, activates both scalar and domain alternatives, these alternatives have to be used up by $O_{\text{EXH-D}}$ and O_σ. The exclusion of the scalar alternative in (46c) entails, together with the assertion, that one of the pre-exhaustified domain alternatives in (46d) must be true, as seen in (47a). The exclusion of the pre-exhaustified domain alternatives in (46d) entails that the scalar alternative is true, as (47b) shows.

(46) a. LF: $O_{\text{EXH-D}} O_\sigma [_{\text{IP}}$ Maria married irgendeinen$_{[+\sigma,+D]}$doctor$]$
b. $[\![[_{\text{IP}}$Maria married irgendeinen$_{[+\sigma,+D]}$doctor$]]\!] =$ $d_1 \vee d_2$
c. $[\![[_{\text{IP}} \ldots]]\!]^{\sigma\text{-ALT}}$ $\{d_1 \wedge d_2\}$
d. $[\![[_{\text{IP}} \ldots]]\!]^{\text{EXH-D-ALT}} =$ $\{d_1 \wedge \neg d_2, d_2 \wedge \neg d_1\}$

(47) a. $(d_1 \vee d_2) \wedge \neg(d_1 \wedge d_2) \Leftrightarrow (d_1 \wedge \neg d_2) \vee (d_2 \wedge \neg d_1)$
b. $(d_1 \vee d_2) \wedge (d_1 \leftrightarrow d_2) \Leftrightarrow (d_1 \wedge d_2)$

Excluding the scalar alternative and the prexhaustified domain alternatives derives a contradiction, as shown in (48). This is a virtue of the analysis, because the derivation of a contradiction helps explaining the behavior of those EFCIs that, like *algún* or *irgendein*, convey a modal component when unembedded. Note that inserting a necessity modal, as in (49a), avoids deriving a contradiction. Strengthening (49b) by conjoining it with the negation of the scalar alternative in (49c) does not entail that one of the pre-exhaustified domain alternatives in (49d) is true, as stated in (50).

(48) $[(d_1 \vee d_2) \wedge \neg(d_1 \wedge d_2) \wedge (d_1 \leftrightarrow d_2)] \Leftrightarrow \bot$

(49) a. LF: $O_{\text{EXH-D}} O_\sigma \Box [_{\text{IP}}$ Maria married irgendeinen$_{[+\sigma,+D]}$ doctor$]$
b. $[\![\Box [_{\text{IP}}$ Maria married irgendeinen$_{[+\sigma,+D]}$ doctor$]]\!] =$ $\Box(d_1 \vee d_2)$
c. $[\![\Box [_{\text{IP}} \ldots]]\!]^{\sigma\text{-ALT}} =$ $\Box(d_1 \wedge d_2)$
d. $[\![O_\sigma \Box [_{\text{IP}} \ldots]]\!]^{\text{EXH-D-ALT}} =$ $\{\Box d_1 \wedge \neg\Box d_2, \neg\Box d_1 \wedge \Box d_2\}$

(50) $\Box(d_1 \vee d_2) \wedge \neg\Box(d_1 \wedge d_2) \not\Rightarrow (\Box d_1 \wedge \neg\Box d_2) \vee (\neg\Box d_1 \wedge \Box d_2)$

Both the scalar and pre-exhaustified domain alternatives can be excluded, then, without deriving a contradiction. Excluding both the scalar and the pre-exhaustified alternatives derives the contingent proposition in (51), which conveys a FCE. If the necessity modal is epistemic, the detected speaker ignorance component is derived.[5]

(51) $[\![(49a)]\!] = \Box(d_1 \vee d_2) \wedge \neg\Box(d_1 \wedge d_2) \wedge (\Box d_1 \leftrightarrow \Box d_2)$
$\Rightarrow \Diamond d_1 \wedge \Diamond d_2 \wedge \Diamond\neg d_1 \wedge \Diamond\neg d_2$

To sum up, if EFCIs activate both scalar and (strengthened) domain alternatives, and active alternatives have to be exhaustified, EFCIs are predicted to derive a contradiction. The derivation of a contradiction can be prevented by inserting a necessity modal. We can then think of the insertion of a covert modal as a last resort strategy that prevents the derivation of a pathological meaning. This accounts for the behavior of those EFCIs that, like *irgendein* or *algún* are grammatical in unembedded contexts, where they convey modality. But a question arises: what about other EFCIs? We discuss them next, focusing on *i*-INDs.

4.2. Should modal insertion be freely available?

Recall that unembedded *i*-INDs are grammatical but do not have a modal component. As we have seen before, the dialogue in (29), repeated in (52) below, is perfectly appropriate, in contrast with other EFCIs.

(52) A: Forood dirooz (ye) ketāb-i xarid.
Forood yesterday (one) book-IND bought-3.SG
'Forood bought a book yesterday.'
B: Which one?

If covert modals can be freely inserted to avoid the derivation of a contradiction, why do *i*-INDs not have a modal component when they are unembedded? To answer this question, it would be useful to point out that it is not just the behavior of *i*-INDs that poses questions. Recall that Romanian *vreun* is ungrammatical when unembedded, as (7), repeated below, shows.

(53) *Monica s-a întâlnit cu vreun prieten.
Monica REFL-have.3SG met with VREUN friend.MASC
'Monica met a friend.' (Fălăuş, 2014: p. 122)

Why is the insertion of a covert necessity modal not a possible way of rescuing (53)? The ungrammaticality of *vreun* in unembedded contexts suggests that the insertion of a covert modal might not be a freely available strategy in all languages, as suggested in Fălăuş (2015). If the insertion of a covert necessity modal is not an option in Romanian, or at least not an option for *vreun*, this item would be predicted to derive a contradiction obligatorily, and this could be behind its deviance. We can understand the behavior of *vreun* vs. the *irgendein/algún* type of EFCIs by making the assumption that modal insertion is not freely available. When modal insertion is a possibility, EFCIs are grammatical, but, as a result of the insertion of

[5] When more than two domain alternatives are at play, this reasoning will derive an epistemic FCE. Something else needs to be said to derive a weaker MVE. On this issue, we refer the reader, again, to Chierchia (2013: chapter 5).

a covert modal, convey a modal component. When modal insertion is not a possibility, an unavoidable pathological meaning is derived, which could be behind the ungrammaticality of *vreun* (Gajewski, 2002).

Turning back to EFCIs, another question arises. If modal insertion is not always a possibility, perhaps it won't be a possibility in the case of *i*-INDs. That would explain why *i*-INDs do not have a modal component. But why are *i*-INDs not ungrammatical? What prevents the derivation of a pathological meaning?

In the next subsection, we explore a natural answer to this question. The derivation of a contradiction in unembedded contexts hinges upon the assumption that both scalar and domain alternatives have to be used up in exhaustification. Exhaustification with respect to scalar alternatives only, or with respect to the strengthened domain alternatives only does not derive a contradiction. One possibility to explore, then, is that modal insertion is not freely available in Farsi, but partial exhaustification is. That would allow to explain the grammaticality of *i*-INDs and the lack of a modal component at the same time. We discuss this possibility next.

4.3. Partial exhaustification as a last resort

Let's get back to the basic configuration in unembedded contexts, with the example in (54), which lists, again, the relevant scalar and pre-exhaustified domain alternatives.

(54) a. LF: $O_{\sigma}[_{\text{IP}}$ Forood bought (ye) book-$\text{i}_{[+\sigma,+D]}$ $]$
b. $[\![[_{\text{IP}} \ldots \text{(ye) book-i}_{[+\sigma,+D]}]]\!] =$ $b_1 \vee b_2$
c. $[\![[_{\text{IP}} \ldots \text{(ye) book-i}_{[+\sigma,+D]}]]\!]^{\sigma\text{-ALT}} =$ $\{b_1 \wedge b_2\}$
d. $[\![[_{\text{IP}} \ldots \text{(ye) book-i}_{[+\sigma,+D]}]]\!]^{\text{EXH-D-ALT}} =$ $\{b_1 \wedge \neg b_2, b_2 \wedge \neg b_1\}$

As we saw before, the exclusion of *both* the scalar and the pre-exhaustified domain alternatives yields a contradiction. The exclusion of the scalar alternative alone doesn't: it delivers the contingent proposition in (55), conveying that Forood bought only one book. This is the attested meaning.

(55) $[\![\text{(54a)}]\!] =$ $(b_1 \vee b_2) \wedge \neg(b_1 \wedge b_2)$

Exhaustification with respect to the pre-exhaustified domain alternatives alone, as in (56a), does not derive a contradiction, either, but rather the contingent proposition in (56b), which conveys that Forood bought both books. This proposition, however, does not correspond to the attested interpretation of the sentence.

(56) a. LF: $O_{\text{EXH-D}}[_{\text{IP}}$ Forood bought (ye) book-$\text{i}_{[+\sigma,+D]}$ $]$
b. $[\![\text{(56a)}]\!] =$ $((b_1 \vee b_2) \wedge (b_1 \leftrightarrow b_2)) \Leftrightarrow (b_1 \wedge b_2)$

If partial exhaustification (i.e. exhaustification with respect to either the scalar or the pre-exhaustified domain alternatives) were available as a way of avoiding the derivation of a contradiction, then no contradiction would be expected to arise in unembedded contexts. That's a good result, since *i*-INDs are allowed in unembedded contexts (universally, in the case of *ye(k)* INDs; at least for some speakers, in the case of bare *i*-INDs.) But partial exhaustification delivers two possible interpretations, and only one is attested, so if partial exhaustification is an option, it has to be restricted to partial exhaustification with respect to the scalar alternatives, since that yields the attested interpretation.

Restricting partial exhaustification to the scalar alternatives can be motivated. There is a crucial difference between partial domain exhaustification and partial scalar exhaustification: partial domain exhaustification delivers a contingent proposition, but one that is equivalent to an alternative (the scalar one.) Chierchia (2013) argues that exhaustification should be restricted in this case, and captures this with the principle below, which directly rules out (partial) domain exhaustification.

(57) *Chierchia's Exhaustification Economy Principle*
Exhaustification is not allowed if it yields a meaning logically equivalent to one of the potential alternatives. (Chierchia, 2013: p.129)

If *i*-INDs allow for partial exhaustification as a last resort strategy to avoid the derivation of a contradiction, and the insertion of a covert necessity modal is not a possibility, we predict their attested interpretation when unembedded: the absence of a covert modal accounts for the absence of their modal component, and partial scalar exhaustification derives the attested uniqueness component. We contend that the possibility of allowing for partial exhaustification is what lies behind the difference between *i*-INDs and the other EFCIs that we discussed above.

To conclude this section, some house keeping is in order. In Chierchia's system $[+\alpha]$ alternatives have to be obligatorily used up by exhaustification operators. That means that the type of LFs that we relied on to illustrate partial exhaustification, like (58), are in fact ruled out. To allow for partial exhaustification, alternatives need to be deactivated, as in (59).

(58) LF: O_σ [$_{\text{IP}}$ Forood bought (ye) book-i$_{[+\sigma,+D]}$]

(59) a. O_σ [$_{\text{IP}}$ Forood bought (ye) book-i$_{[+\sigma,-D]}$]
b. $O_{\text{EXH-D}}$ [$_{\text{IP}}$ Forood bought (ye) book-i$_{[-\sigma,+D]}$]

We assume that $[-\alpha]$ alternatives need not be discharged by an exhaustifier, but are still visible in the pragmatics proper, and, therefore, to the Exhaustification Economy Principle.

4.4. *ye(k) i*-INDs vs. bare *i*-INDs

Before concluding this section, let us briefly get back to one of the observations made in Section 2: We pointed out that there is a contrast between *ye(k) i*-INDs and bare *i*-INDs when unembedded: While unembedded *ye(k) i*-INDs are grammatical in all registers, unembedded bare *i*-INDs vary: they are grammatical for all speakers in the formal register, but not for all speakers in the informal register.

The contrast in unembedded contexts for some speakers in the informal register would follow if, for those speakers, *ye(k) i*-INDs activate both scalar and domain alternatives (they are $[+\sigma,+D]$) but bare *i*-INDs only activate domain alternatives (they are $[-\sigma,+D]$), if we assume that deactivation of alternatives ($[+\alpha]\rightarrow[-\alpha]$) is possible, but activation ($[-\alpha]\rightarrow[+\alpha]$) is not, and that complete deactivation (going from $[+\alpha,+\beta]$,$[-\alpha,+\beta]$ or $[+\alpha,-\beta]$ to $[-\alpha,-\beta]$) is not possible either.

For those speakers that categorize bare *i*-INDs as $[-\sigma,+D]$, the situation is the following: $[+D]$ requires $O_{\text{EXH-D}}$, as in (60). But, as we saw before, this results in a violation of the Exhaustification

Economy Principle in (57), hence the configuration is ruled out (and complete deactivation of the alternatives, ending in $[-\sigma,-D]$ is not a possibility.)

(60) $O_{\text{EXH-D}}$ [NP-i $_{[-\sigma,+D]}$]

In the case of *ye(k) i*-INDS , $[+\sigma,+D]$ requires O_σ and $O_{\text{EXH-D}}$, but, as we saw, that derives a contradiction. Deactivation of the scalar alternatives ($[+\sigma]\rightarrow[-\sigma]$) results in a violation of the Exhaustification Economy Principle. Deactivation of the (strengthened) domain alternatives ($[+D]\rightarrow[-D]$) solves the issue, deriving the attested uniqueness component.

5. Conclusion

Let's sum up. With the alternative-based analysis of EFCIS presented in Chierchia (2013), EFCIS are predicted to derive pathological meanings in unembedded contexts. Previous literature relied on one last resort strategy (the insertion of a covert modal) to avoid the pathology. In this paper, we have proposed that *i*-INDS illustrate the existence of a second last resort strategy for EFCIS: the possibility of deactivating alternatives (and therefore have only partial exhaustification.)

If our discussion is on the right track, neither strategy is freely available in all languages. It is reasonable to assume that EFCIS vary along two parameters: whether they allow for the insertion of a covert modal or not [$\pm\,\Box$], and whether they allow for partial exhaustification or not [$\pm\, P$]. As summarized in the table below, *vreun* can be taken to exemplify a situation where neither covert modal insertion nor partial exhaustification is possible. The *irgendein / algún* type illustrates what happens when partial exhaustification is not possible, but covert modal insertion is. Finally, *i*-INDS illustrate a case where covert modal insertion is not available, but partial exhaustification is.

(61)

	$\Box$-insertion	Partial Exh
irgendein / algún-type EFCIS	$+$	$-$
vreun	$-$	$-$
-*i* INDS	$-$	$+$

This proposal raises some not so trivial questions. For one, we need to understand *why* covert modal insertion is not freely available. In discussing the role of covert modals in licensing EFCIS, Chierchia (2013: 293) puts forth the question of whether these covert modals should be part of the lexicon across languages. We can assume that they are not. Alternatively, it could still be the case that covert modals *are* freely available, but that some property teasing them apart from overt modals clashes with some EFCIS like Romanian *vreun* or the *i*-INDS discussed in this paper. Chierchia (2013: 294) sketches a proposal along these lines by proposing a constraint that disallows *vreun* in the scope of a covert modal on the basis of the observation that it competes with another free choice item. Determining the extent to which that possibility can be extended to the case of *i*-INDS will be left to further research.

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Now and *then*: Perspectives on positional variance in temporal demonstratives[1]

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Abstract. Despite its reputation as an archetypal example of indexicality, the temporal adverb *now* has many non-indexical uses. It is not surprising, then, that recent work has instead focused on an intuition that *now* evokes some notion of change or contrast in the preceding discourse. We argue that this intuition should not be directly encoded in the semantics of *now*, but rather should be derived as a product of how its semantics interacts with information structure. Our argument is guided by a previously unnoticed contrast in its interpretation based on its position in the sentence. We propose that, in sentence-initial position, *now* is a contrastive topic, which contributes to the intuition that it "pushes forward" the narrative. Its true semantic shape is revealed in final position. This is, we propose, indexical, though not to the utterance time, but a more flexible assessment time. We extend our account of *now* to *then*, treating them as a proximal-distal pair of temporal demonstratives, identifying some similarities and some differences in how they are interpreted in a narrative.

Keywords: indexicality, tense, temporal adverbials, information structure, contrastive topic

1. Introduction

It is common in introductions to indexicality to use *now* as an example of an indexical temporal adverb, denoting the time of utterance. As students quickly note, however, there are many occasions where *now* does not seem to have much to do with the actual utterance, particularly in narrative passages (Dry, 1979; Kamp and Rohrer, 1983: 265–266; Kamp and Reyle, 1993: 595; a.o.).

(1) a. Someone touched his elbow so timidly that he thought it had been accidental, until the gesture was repeated with more insistence. **Now** he turned and saw Nebamun walking beside him. (Anton Gill, *City of Dreams*)

b. An education at Oxford appealed to a new class of rich and well-to-do men who wished to use it to improve the prospects of their sons. The Colleges were **now** therefore able to charge fees[...] (C. D. Darlington, "Oxford unreformed: The uses of abuses")

c. Fei Yen bowed deeply, the two maids on either side of her copying her automatically. The young Prince had showered and changed since she had last seen him. He wore red **now**[...] (David Wingrove, *The Middle Kingdom*)

In the face of such examples, an indexical semantics for *now* would seem to be impossible, and contemporary semantic accounts have largely abandoned one.

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Instead of indexicality, recent work on *now* has been animated by the intuition that it can invoke a recent change in, or some notion of contrast with, the preceding discourse (e.g., Recanati, 2004: 19; Lee and Choi, 2008; Hunter, 2010: 53–86; Lee, 2017). In (1a), for instance, the protagonist's turning takes place only after his elbow was touched again, with *now* seeming to pick out some time interval after the event of the preceding sentence. Many of these theories bake some notion of change or contrast into the semantics of *now*, in the end treating it as fundamentally different from other temporal frame adverbials.

While we are sympathetic to the intuition that *now* invokes some change or contrast that "pushes forward" a narrative, we will argue that this intuition is a product of its semantics, in combination with information structure. Our starting point is a hitherto unrecognized positional contrast. When *now* is in sentence-initial position, it can "push forward" the narrative. However, when it is not — when it is, for instance, sentence final — it is not able to. It thus cannot be the semantics of *now* alone that is driving the intuition about change or contrast. The positional asymmetry, we will propose, tracks the information structure associated with these positions. When *now* is in initial position, it is a contrastive topic, which contributes to how the narrative is pushed forward.

In turn, *now*'s true semantic shape is best revealed in positions where it is not associated with a particular information-structural category, such as sentence-final position. This shape is, ultimately, indexical, though not to the utterance time, but rather a more flexible assessment time (Schlenker, 2004; Sharvit, 2004, 2008; MacFarlane, 2014). As it happens, several other temporal expressions exhibit a similar disassociation from the utterance context. These include temporal adverbials, such as *today* or *tomorrow*, in free indirect discourse (Banfield, 1982; Doron, 1991; Sharvit, 2004, 2008; Eckardt, 2015), as well as the present tense in its historical use (Schlenker, 2004; Anand and Toosarvandani, 2017, 2018). There are accounts of these expressions, too, in terms of indexicality to the assessment time.

In the next section, we first lay out a positional generalization for *now*, focusing on short, two sentence discourses. In Section 3, we offer an overview of the semantics of *now* as assessment time sensitive, before turning, in Section 4, to a more detailed discussion of this account. Coupled with contrastive topic and independent constraints on discourse interpretation, it yields the intuition of a forward-pushing narrative. In Sections 5 and 6, we show how this account can be extended, first by looking at how *then* differs from *now*, and then at larger discourses beyond two-sentence sequences.

2. A positional generalization about *now*

To start, we adopt Altshuler's (2016: 13–59) characterization of the intuition about change or constrast. In discourses like (1a) above, as well as in (2) below, he describes *now* as giving rise to a *forward-shifted* interpretation relative to a salient event in the preceding discourse, corresponding roughly to a gloss of "with this having happened" (cf. Hunter, 2010: 53–86).

(2) I could've located this place even without the brilliance of the falling snow, for this spot, razed by fire, was where I'd ended the life of my companion of twenty-five years. **Now**, snow covered and erased all the clues that might have been interpreted as signature[. . .]

(Orhan Pamuk, *My Name is Red*)

By Altshuler's (2016: 36) reading, the snow's covering and erasing the clues takes place quite some time after the murder of the speaker's companion. It is not always necessary, however, for such a great length of time to have elapsed. In (1a), the protagonist's turning presumably takes place right after his elbow was touched again.

Altshuler proposes to encode this forward movement directly in the semantics of *now*. He takes it to presuppose a salient event in the preceding discourse, locating the onset of the prejacent eventuality within its final (or result) state.

(3) $[\![\text{now}_j\ \phi]\!] = 1$ iff there is an eventuality e such that $[\![\phi]\!](e) = 1$ and the onset of e is in the final state of $g(j)$; defined iff $g(j)$ is an event

There are a couple reasons we are wary of encoding change directly in the semantics of *now*. First, there are attested examples where a sentence with *now* describes an eventuality that overlaps the most recent event (Hunter, 2011: 377; Lee, 2017: 631).

(4) Darwin **gave up** his original assumption that evolution occurred best in small, isolated populations, because he **now feared** that small populations would not throw up enough individual variants for selection to be effective.
(Peter J. Bowler in *Variation: A Central Concept in Biology*)

Darwin's fearing clearly temporally overlaps his giving up his original assumptions about evolution. In principle, this interpretation could be compatible with the semantics in (3), if *now* here is anaphoric to a salient event located even farther back in the discourse than the most recent sentence, so that there is just accident overlap with the preceding sentence.

It is possible, however, to control for this possibility, using two-sentence discourses where the putative antecedent for *now* can only be the event described by the first sentence. In such simple discourses, there are indeed clear-cut cases where a *now* sentence is interpreted as temporally overlapping the preceding sentence. In particular, this is the case when *now* occurs in sentence-final position.

(5) The janitor turned off^{e_1} the lights. The room was empty^{s_2} **now**. $e_1 \circ s_2$

In fact, an overlapping interpretation seems to be obligatory here, something that can be shown more directly by looking at cases where an overlapping interpretation would be anomalous. In Partee's (1984) example in (6), the medial sentence is infelicitious because the state it describes cannot overlap the event described by the first sentence.

(6) People began^{e_1} to leave. #The room was empty^{s_2}. The janitors came^{e_3} in. $*e_1 \circ s_2$
(Partee, 1984: 262)

If *now* is intrinsically capable of forward shifting, it should be able to override this default interpretation for statives, in which they temporally overlap the most recent event (Hinrichs, 1986; Partee, 1984). But it cannot, at least not in final position.[2]

(7) People began^{e_1} to leave. #The room was empty^{s_2} **now**. $*e_1 \circ s_2$

For this reason, it is unlikely that forward-shifting is part of the semantics of *now* proper. Strikingly, however, in sentence-initial position, *now* does give rise to a forward-shifted interpretation, allowing it to avoid the infelicity arising from an incompatible state (much like a temporal adjunct clause, e.g., *When the room was empty…*; Partee, 1984: 262).

(8) People began^{e_1} to leave. **Now**, the room was empty^{s_2}. $e_1 < s_2$

The availability of forward shifting thus depends on the position of *now* in the sentence, an empirical generalization we can characterize as follows:

(9) *Positional Generalization (preliminary version)*
For a sentence S containing *now* and a sentence S' that immediately precedes S,
(i) if *now* is in initial position, S does not overlap S', but rather temporally follows S';
(ii) if *now* is in final position, S is "roughly simultaneous" with S'.

In sum, a forward-shifted interpretation should derive from its semantics, but not be hard-wired into it. We advance such a semantics next, which treats *now* essentially as a temporal demonstrative.

3. A bicontextual semantics for *now*

As we noted above, the apparent non-indexical behavior of *now* is not atypical, as other temporal expression exhibit the same behavior. Temporal adverbials such as *today* and *tomorrow* famously ignore the actual time of utterance in free indirect speech (Banfield, 1982; Doron, 1991; Sharvit, 2004, 2008; Eckardt, 2015). And, in its historical use, the simple present describes events that do not take place at the time of utterance (Schlenker, 2004; Anand and Toosarvandani, 2017, 2018).

There are accounts for both these cases that assume natural language expressions are interpreted relative to two contexts: a *context of utterance* (u) and a *context of assessment* (a). Individual expressions can be sensitive to one, the other, or both of these contexts. Adopting the division that Sharvit (2004, 2008) proposes, local pronouns are sensitive to the utterance context (10), while tense and temporal adverbials, such as *today*, are sensitive to the assessment context (11).

[2] With *now* in final position, there does not have to be strict temporal overlap: a state or event can immediately follow the preceding event.

(1) a. John turned^{e_1} off the light. It was dark^{s_2} **now**.
b. John entered^{e_1} the room. The phone rang^{e_2} **now**.

It is unclear whether this is the same "just after" relation found in narrative progression, which Dowty (1986) shows can also hold of states. We have chosen our examples above to control for this confounding factor.

(10) a. $[\![\text{I}]\!]^{u,a,g} = \text{SPEAKER}(u)$

b. $[\![\text{you}]\!]^{u,a,g} = \text{ADDRESSEE}(u)$

(11) a. $[\![\text{PRES}_i]\!]^{u,a,g} = g(i)$; defined iff $g(i) \subseteq \text{TIME}(a)$

b. $[\![\text{tonight}]\!]^{u,a,g} =$ the night of the day surrounding $\text{TIME}(a)$

In the default case, the assessment context and utterance context are the same. Then, tense and temporal adverbials are well-behaved, tracking the time of the actual utterance.

The non-indexical uses of tense and temporal indexicals arise when the two contexts come unmoored from each other. For free indirect discourse, Sharvit (2004, 2008) proposes a silent attitude operator, which shifts the assessment context, and hence also the temporal indexicals sensitive to it. And, for the historical present, Anand and Toosarvandani (2017, 2018) propose that the assessment context can float free of the utterance context even in root contexts, subject to certain pragmatic principles (cf. Schlenker, 2004).

This is how, we propose, the non-indexical uses of *now* come about. It is essentially a temporal demonstrative, as shown in (12a), referring to a time interval that is part of the assessment time.

(12) a. $[\![\text{now}_j]\!]^{u,a,g} = g(j)$; defined iff $g(j) \subseteq \text{TIME}(a)$

b. $[\![\text{then}_j]\!]^{u,a,g} = g(j)$; defined iff $g(j) \circ\!\circ\, \text{TIME}(a)$[3]

As Recanati (2004) suggests, we can think of *now* as the proximal member of a demonstrative pair with *then*, its distal companion. While *now* picks out a time interval inside the assessment time, *then* refers to a time interval outside of it, as in (12b).

If *now* picks out a time interval, it must be able to compose with the rest of the sentence. We assume this happens via a null preposition IN, which, as defined in (13), locates the reference time somewhere within the *now*-interval.

(13) $[\![\text{IN}]\!]^{u,a,g} = \lambda J \lambda I.1$ iff $I \subseteq J$

To sketch the compositional process, consider the second sentence in (14), repeated from (5) above.

(14) The janitor turned off^{e_1} the lights. The room was empty^{s_2} **now**. $e_1 \circ s_2$

Given its semantics, the bimorphemic adverbial [IN now$_j$] constrains the extent of the reference time, like a temporal frame adverbial: it must be contained inside a time interval that is itself contained in the assessment time.

At first glance, this engenders a conflict with what one might think is the most natural semantics for past tense, which locates the reference time *outside* the assessment time.

(15) $[\![\text{PAST}_i]\!]^{u,a,g} = g(i)$; defined iff $g(i) < \text{TIME}(a)$

[3]For time intervals I and J, $I \circ\!\circ\, J$ iff I and J are disjoint.

However, simple past morphology is not infrequently analyzed as polysemous across several temporal notions (cf. Kratzer, 1998, Kamp and Reyle, 1993: 598–601). Kratzer (1998), for instance, proposes that the simple past in English also conceals a perfect-like interpretation, a proposal rooted in some fine-grained differences between it and its German equivalent, the *Präteritum*.

One of these differences is that the simple past is good out of the blue, but the *Präteritum* is not, unlike the *Perfekt* (see Dickey, 2001 for similar facts on Dutch).

(16) Context: You are looking at churches in Italy.

a. Who **built** this church? Borromini **built** this church.

b. # Wer **baute** diese Kirche? Borromini **baute** diese Kierche.

(Kratzer, 1998: 106)

When a contextually-salient past time interval has already been introduced, however, both the simple past and the *Präteritum* are possible. Kratzer suggests that the English phonology masks two distinct morphemes, which correspond in some way to the two German forms. One of these is like PAST, defined in (15), and the other has roughly the semantics of the R(EMOTE)-PAST in (17).

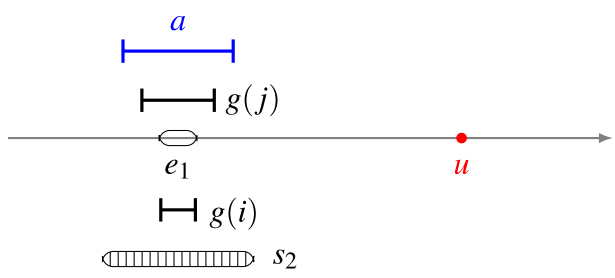
(17) $[\![\text{R(EMOTE)-PAST}_i]\!]^{u,a,g} = g(i)$; defined iff $g(i) \subseteq \text{TIME}(a) < \text{TIME}(u)$

Only R-PAST is compatible with *now*. Assuming its existence, the internal composition of (14) is shown in (18): *now* combines with the verb phrase, which is simplified to be a description of times.

(18)
- 1 iff **the-room-be-empty**$(g(i)) \wedge g(i) \subseteq g(j)$; defined iff $g(i) \subseteq \text{TIME}(a) < \text{TIME}(u)$ and $g(j) \subseteq \text{TIME}(a)$
  - R-PAST$_i$ $g(i)$; defined iff $g(i) \subseteq \text{TIME}(a) < \text{TIME}(u)$
  - $\lambda I.1$ iff **the-room-be-empty**$(I) \wedge I \subseteq g(j)$; defined iff $g(j) \subseteq \text{TIME}(a)$
    - VP: the room was empty $\lambda I.1$ iff **the-room-be-empty**(I)
    - $\lambda I.1$ iff $I \subseteq g(j)$; defined iff $g(j) \subseteq \text{TIME}(a)$
      - IN $\lambda J \lambda I.1$ iff $I \subseteq J$
      - now$_j$ $g(j)$; defined iff $g(j) \subseteq \text{TIME}(a)$

This sentence describes an event in the past of the utterance time, which is located within a *now*-interval that is itself contained in the assessment time.

(19)



For the discourse in (14), then, the *now* sentence has an overlapping interpretation because of how the *now*-interval is resolved. If it is anaphoric to the time of the most recent event — namely, the event described by the preceding sentence — the state of the room being empty must overlap the event of turning off the light. Significantly, a forward-shifted interpretation is not available, as there is simply no salient time interval posterior to the event of the first sentence.

4. How to shift forward

This suffices as a basic theory of the semantics of *now*. The remainder of this paper is dedicated to figuring out how, in sentence-initial position, *now* gains the ability to forward shift. Our intuition is that it has a particular information structure in this position.[4]

Sentence initially, *now* cannot bear a narrow focus, realized prosodically as a falling pitch accent or "A-accent" (represented below with small caps), unlike in final position. (More generally, focus is never associated with the left periphery in English.)

(20) When does Liz leave?

a. # [NOW]$_{\text{F}}$, she leaves.

b. She leaves [NOW]$_{\text{F}}$.

It can, however, be a topic, like other frame adverbials (Dickey, 2001: 69–70). Specifically, we take them to be *contrastive topics*, bearing a rising pitch accent or "B-accent" (represented with underlining) (Büring, 1997, 2003; Constant, 2014).[5]

(21) (Yesterday,) it was raining.

a. [Now]$_{\text{T}}$, [it is SUNNY]$_{\text{F}}$.

b. ?? [It is SUNNY]$_{\text{F}}$ [now]$_{\text{T}}$.

Given that *now* has special information-structural properties in initial position, it seems reasonable to us to relate forward shifting to the pragmatics of contrastive topic. This will exclude interpretations where the *now*-interval overlaps with or is anterior to the time of the preceding sentence.

[4]For compositional concreteness, we assume that *now* moves into initial position, somewhere in the left periphery, stranding the "preposition."

[5]We are uncertain whether *now* in final position can be a contrastive topic (21b). This would require it to follow the focus, which may simply not be possible in English, as it is not possible in German (Wagner, 2012: 22–23).

Since our argument is fairly involved, it is worth previewing. Excluding an overlapping interval is actually relatively straightforward. At an intuitive level, contrastive topic requires there to be a salient temporal interval that is distinct, and one might also presume disjoint, from the *now*-interval. In two-sentence discourses, this means that it will have to be disjoint from the time of the preceding sentence. To exclude an anterior interval, we will invoke an additional pragmatic constraint on the update of the assessment time, building on our previous claim that moving $\text{TIME}(a)$ backwards is sensitive to stringent anaphoricity conditions (Anand and Toosarvandani, 2018). The only remaining possibility thus is that *now* refers to a time interval that follows the time of the preceding sentence.

4.1. The pragmatics of contrastive topic

Büring (1997, 2003) proposes a theory of contrastive topic that builds on Rooth's (1992) alternative semantics for focus. In this account, both focus and contrastive topic introduce alternatives. These are nested, though, so that a sentence containing a contrastive topic has, as its alternative set, a set of *sets of propositions* (see also Constant, 2014).

For the sentence in (21a), where *now* occurs in initial position and bears a contrastive topic, its alternative set is a set of sets of propositions of the form 'In interval J, p was true', for some proposition p and some time J:

(22) $[\![[\text{now}_j]_{\text{T}}\ [\text{PRES}_i \text{ it be sunny}]_{\text{F}} \text{ IN t}]\!]^{u,a,g}_{\text{ALT}} = \{\{P(I) \wedge I \subseteq J \mid I \in D_i \wedge P \in D_{\langle i,t\rangle}\} \mid J \in D_i\}$

This alternative set could, alternately, be thought of as a set of questions of the form 'At time J, what was it?', constituting a strategy of inquiry for resolving a higher-level conversational goal. By answering each of these questions in turn, conversational participants would provide a complete answer to the question *When was it what?*.

(23) (When was it what?)

(What was it before?) (What is it now?)

[<u>Yesterday</u>]$_{\text{T}}$, [it was RAINING]$_{\text{F}}$. [<u>Now</u>]$_{\text{T}}$, [it is SUNNY]$_{\text{F}}$.

A sentence containing a contrastive topic evokes such a strategy of inquiry, providing a partial answer to one of the subquestions. Other subquestions in the strategy and their answers can be represented overtly in the discourse, as in (21), or they might be covert.

The connection between a sentence's alternative set and the strategy of inquiry in which it participates is enforced via a congruence constraint (cf. Büring, 2003: 503):

(24) *Contrastive Topic Congruence*
A sentence S containing a contrastive topic presupposes that there is a question Q in the discourse such that:
(i) Q is part of the strategy of inquiry evoked by S, i.e., $[\![Q]\!] \in [\![S]\!]_{\text{ALT}}$,

(ii) S entails an answer to Q, i.e., $\exists p \in [\![Q]\!]$ $([\![S]\!] \subseteq p)$, and
(iii) there is a question Q' such that $Q' \neq Q$ and $Q' \in [\![S]\!]_{\text{ALT}}$.

Importantly, a sentence with a contrastive topic presupposes two questions: one that it entails an answer to and at least one other subquestion forming part of the same strategy of inquiry.

With this in mind, consider again the discourse in (8), which has the following information structure:

(25) The people began to^{e_1} leave. $\boxed{\text{Now}}_{\text{T}}$, [the room was EMPTY]$_{\text{F}}{}^{s_2}$. $e_1 < s_2$

With this topic-focus configuration, the *now* sentence evokes a set of alternative questions of the form ‘At I_J, what happened?’ for some time I_J, just like the sentence in (22). This corresponds to a strategy of inquiry directed toward answering the question *When did what happen?*.

(26) (When did what happen?)

(What happened at $I_{j'}$?) (What happened at I_j?)

[R-PAST$_{i'}$ The people began to LEAVE]$_{\text{F}}$. [$\underline{\text{Now}_j}$]$_{\text{T}}$ [R-PAST$_i$ the room was EMPTY]$_{\text{F}}$.

The *now* sentence entails an answer to one of the subquestions in this strategy. In this case, the contrastive topic is licensed because another subquestion of this strategy is under discussion, one that the preceding sentence evokes.

We propose that it is because these two sentences are linked, by being answers to distinct questions in the same strategy, that the *now*-interval cannot overlap the time of the preceding sentence. In general, alternatives evoked by a focus or contrastive topic must be distinct from one another (Rooth, 1992; Wagner, 2006, cf. Büring, 2003: 523). In (27), for example, the adjectives *red* and *new* are not alternatives to one another, and hence cannot contrast with each other, because their extensions are overlapping.

(27) # Liz bought a [RED]$_{\text{F}}$ convertible, before buying a [NEW]$_{\text{F}}$ one.

Formulating the correct definition of distinctness is a thorny issue, but it is possible to define a simple version based on disjointness:

(28) *Distinctness of Alternatives*
For any expression E, the members of the alternative set for E are disjoint, i.e., $\forall X, Y \in [\![E]\!]_{\text{ALT}}\, (X \neq Y \rightarrow X \cap Y = \varnothing)$.

The alternative set for *now* will thus include the *now*-interval itself, as well as some other time intervals that are disjoint from it. This suffices to rule out an overlapping relation in two-sentence discourses, including the simultaneous interpretation that final *now* is so congenial with.

4.2. No going backwards

With an overlapping interpretation ruled out, it now remains to be shown that only a forward-shifted interpretation is possible for *now* in initial position.

Importantly, temporal backshifting — interpreting the *now*-interval anterior to an interval introduced by an earlier sentence — is never allowed, regardless of the position of *now* (Hunter, 2011: 377). In (29), whether *now* is initial or final, the enjoying cannot be located prior to the incurring of Trump's wrath (e.g., the time of the campaign).

(29) How things have changed since the campaign! Cohen plead guilty^{e_1} last week and incurred^{e_2} Trump's wrath. {#**Now**,} he enjoyed^{s_3} his full support {#**now**}.
$*e_1, e_2 > s_3$

Since this restriction holds across positions, we propose that it follows from an independent constraint on the location of the assessment time.

In work elsewhere (Anand and Toosarvandani, 2018), we observe that the historical present is incompatible with backwards temporal sequencing:

(30) a. The administration fires^{e_1} Mike. He loses^{e_2} his house. $e_1 < e_2$
b. The administration fires^{e_1} Mike. He meets^{e_2} with the ambassador. $*e_1 > e_2$

If historical present uses the present tense in (11a), but involves locating the assessment time somewhere prior to the utterance time, this contrast demonstrates that, insofar as $\text{TIME}(a)$ can be updated throughout a discourse, it cannot go backwards. Accordingly, we proprosed a two-pronged constraint on how $\text{TIME}(a)$ is updated:

(31) *Constraints on Assessment Time Shift (CATS)*
For a sentence S and an eventualities stack E, S can be evaluated with respect to contexts u and a such that:
a. $\text{TIME}(a) := \text{TIME}(u)$, or
b. $\text{TIME}(a) := t$ such that for e_0, the top of E, $\forall t'(t' < t \rightarrow t' < \tau(e_0)) \wedge \forall t'(t' < \tau(e_0) \rightarrow t' < t)$
(cf. Anand and Toosarvandani, 2018: 80)

The assessment time can always be set to the utterance time, an option that is probably the default. In addition, it can be updated to align with the most recent eventuality introduced in the discourse, represented as the top of an eventualities stack (cf. Bittner, 2008). It is this latter option, coupled with the semantics of PAST, which allows backshifting with the simple past in English. The same possibility does not, however, arise for historical uses of the simple present. In (30b), updating the assessment time to the run-time of e_1 will, because of the semantics of PRES, only locate e_2 during e_1.

While CATS was proposed to account for the contrast in (30), it is intended as a general theory of assessment time updating. We take the lack of backshifting with *now* as evidence for its broad applicability. For the *now* sentence in (29), CATS permits the assessment time to be updated and anchored to e_2. However, if this sentence is R-PAST, it will, like the present tense, restrict the reference time, and hence also the "now"-interval, to overlap the time of e_2. That is, the *now*-interval cannot be anterior to e_2 because it is only compatible with a past tense, R-PAST, that is incompatible with backshifting.

4.3. Forward movement as narrative progression

Let's take stock. In the previous section, we built a semantics for *now* that captures the simultaneous interpretation that arises when it is in final position. In this section, we have proposed that, in initial position, it is a contrastive topic. A constraint on the disjointness of alternatives ensures that, in this position, the *now*-interval does not overlap the time of the preceding sentence. And, as we just argued, an independent constraint on assessment time update prohibits a *now*-interval from being anterior to the preceding sentence. Put together, these only permit initial *now* to be forward-shifted.

This is a solution to the central puzzle of this paper, though one final issue remains to be resolved. If the only possible referent for *now* in initial position must be "in the future" of the preceding discourse, what is this time? As a temporal demonstrative, *now* should refer to a salient time interval, but in the discourses we have been looking at, it is not clear what this interval is. In (32), for instance, no time after the wrath incurring event is mentioned before the *now* sentence itself is uttered.

(32) Cohen incurred^{e_1} Trump's wrath yesterday. **Now**, his lawyer made^{e_2} a huge revelation. $e_1 < e_2$

While we do not have a complete answer to this question, we think one can be found in the theory of narrative progression and how it allows, in general, for tenses to find salient temporal intervals.

Narrative progression is typically conceived of as a default, available when no other temporal order is imposed between sentences (Lascarides and Asher, 1993). This idea can be operationalized in terms of strategies of inquiries:

(33) *Narration as Default*
A strategy of inquiry containing the question "What happened next?" is always available.

When the discourse context does not support another strategy of inquiry, this default strategy is available. This introduces a salient time interval for *now* to pick out, even if the temporal location of the interval is not entirely clear.

The strategy of inquiry for the discourse in (32) is the following, then, where the *now* sentence answers a subquestion made available by Narration as Default:

(34) (What happened?)

(What happened yesterday$_{j'}$?)
Cohen PAST$_{j'}$ incur Trump's wrath yesterday$_{j'}$.

(What happened next$_j$?)
[Now$_j$]$_T$ [PAST$_i$ his lawyer make a huge REVELATION]$_F$.

The time interval this subquestion asks about must, at the very least, follow reasonably closely the time of e_1. This is somewhat reminiscent of the traditional characterization of narrative progression in which events are described as taking place "immediately after" one another (e.g., Hinrichs, 1986; Partee, 1984). A better gloss might be something more like "next in the story" (see Lee, 2017 for a similar idea).

It is worth noting, too, that unambiguously demonstrative expressions can, just like *now*, have a similar "next" meaning:

(35) Cohen incurred^{e_1} Trump's wrath. **At that point**, his lawyer hinted^{e_2} about bombshell revelations. **At that point**, Giuliani lambasted^{e_3} Cohen further. $e_1 < e_2 < e_3$

This suggests that the forward movement found with *now*, though restricted to narrative contexts, is of a piece with that exhibited by other demonstratives, and not simply encoded in the semantics of *now* itself.

5. *Now* and *then*

This account can be extended to *then*, which in most cases has much the same interpretation as *now*. In final position, it must be simultaneous (36b), while in initial position it can be forward shifted (36a).

(36) a. People began^{e_1} to leave. **Then**, the room was empty^{s_2}. $e_1 < s_2$
b. # People began^{e_1} to leave. The room was empty^{s_2} **then**. $*e_1 \circ s_2$

As a distal demonstrative, *then* picks out a time interval that is disjoint from the assessment time, as we proposed in (12b). In initial position, its lack of an overlapping interpretation follows from the same logic we laid out in Section 4.1 for *now*. It is a contrastive topic that evokes a strategy of inquiry keyed to the disjoint alternatives of the *then*-interval. If a preceding sentence answers one subquestion in this strategy, the *then* sentence will necessarily describe an eventuality located within a non-overlapping time interval.

Unlike with *now*, however, a backshifted interpretation does appear to be possible with *then* in initial position. In (37), Cohen's enjoying Trump's support can precede his incurring his wrath; compare this to (29).

(37) How things have changed since the campaign! Cohen plead guilty^{e_1} last week and incurred^{e_2} Trump's wrath. **Then**, he enjoyed^{s_3} his full support. $e_1, e_2 > s_3$

It is relevant here that *then* is only compatible with PAST, which was defined in (15). (It should be clear why *then* is incompatible with R-PAST: while the former would locate the reference time outside of the assessment time, the latter would require it to be contained inside it.) This past tense only requires the reference time to be anterior to the assessment time. In (37), the assessment time could thus simply remain moored to the utterance time throughout the discourse, or it could be updated for the *then* sentence to e_2. In either case, PAST would not prohibit the *then*-interval, which must be disjoint from the assessment time, from being located anterior to e_2.

Interestingly, the possibility of backshifting disappears as soon as the size of the discourse is reduced to two sentences. In (38), only forward movement is possible. Intuitively, this is because it is not clear what the *then*-time anterior to the wrath-incurring event would be.

(38) Cohen incurred^{e_1} Trump's wrath yesterday. **Then**, he enjoyed^{e_2} his full support. $*e_1 > e_2$

We trace the impossibility of backshifting in (38) to the pragmatics of contrastive topic. It requires all time intervals to be contextually retrievable, though not necessarily given, something that perhaps could be traced ultimately to the pragmatics of questions. The time intervals to which the subquestions in a strategy of inquiry are keyed must be contextually retrievable.

For the two-sentence discourse in (38), the only possible strategy of inquiry is the following one:

(39) (When did Trump feel what towards Cohen?)

- (What did Trump feel towards Cohen yesterday$_{j'}$?)
- (What did Trump feel towards Cohen at t_j?)
  - [Then$_j$]$_{\mathrm{T}}$ PAST$_i$ he [enjoyed his full SUPPORT]$_{\mathrm{F}}$.

The subquestions are keyed either to a time in the day before the utterance, made retrievable by the first sentence, or to a time after it, via Narration as Default (33). Thus, there is no sub question in the strategy the *then* sentence could answer that would give rise to a backshifted interpretation. This contrasts with the three-sentence discourse in (37), where the first sentence makes a suitable time interval available.

Finally, as we have laid it out, the account only permits *now* to occur with R-PAST and *then* with PAST. This may seem like a strange consequence. But, in fact, it may allow us to understand a subtle perspectival shift induced by substituting one of these demonstratives for the other. Consider the following minimal pair:

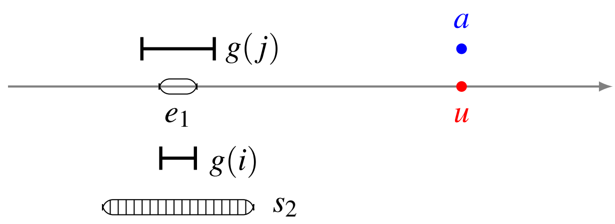
(40) a. The janitor turned off^{e_1} the lights. The room was empty^{s_2} **now**. $e_1 \circ s_2$

b. The janitor turned off^{e_1} the lights. The room was empty^{s_2} **then**. $e_1 \circ s_2$

In both discourses, the second sentence temporal overlaps the first. But, in (40a), the room being empty is described from the perspective of the time at which the lights are turned off, while in (40b), it is described from some other vantage point, possibly from the perspective of the actual utterance.

This perspectival shift corresponds to different locations for the assessment time. For *now* in (40a), $\text{TIME}(a)$ includes the *now*-interval, consequently including the reference time of the first sentence as well, as depicted in (19). By contrast, for *then* in (40b), the assessment time cannot overlap the reference time of the first sentence:

(41)



Because of the semantics of PAST, the assessment time must follow the time of the *then* sentence. One possibility is to locate it at the utterance time, a configuration that matches the more distant perspective found intuitively in this discourse.

6. Revisiting the positional generalization

Looking at two-sentence discourses, the positional generalization in (9) claims that initial *now* is forward-shifting and final *now* is simultaneous. In more complex discourses, this generalization has an obvious counterexample. In initial position, *now* can have an overlapping interpretation with a preceding sentence (cf. Hunter, 2011: 377, Lee, 2017: 624).

(42) They met^{e_1} by accident, several hours later, in one of the bright, high-ceilinged corridors leading to the gardens. [. . .]Fei Yen bowed^{e_2} deeply, the two maids on either side of her copying her automatically. The young Prince had showered^{e_3} and changed^{e_4} since she had last seen him. **Now**, he wore^{e_5} red. $(e_3, e_4 <)\ e_2 \circ e_5$
(modified from: David Wingrove, *The Middle Kingdom*)

This is nothing more, though, than a problem for our initial generalization. Such flexibility is, in fact, expected under our account of forward-shifting as a product of contrastive topic.

In the two-sentence discourses we have been looking at, the first sentence has always answered a sister subquestion in the strategy of inquiry evoked by contrastive topic. Nothing, however, actually requires a preceding sentence to participate in the strategy in this way. The discourse in (42) involves the following strategy:

(43) (When did he wear what?)

(What did he wear several hours before$_{j'}$?) (What did he wear at t_j?)

$[\underline{\text{Now}_j}]_{\text{T}}$ R-PAST$_i$ he wore $[\text{RED}]_{\text{F}}$.

While material farther back in the passage might address one of the other subquestions in the strategy — what the Prince was wearing earlier that day before the accidental meeting — the sentences immediately preceding *now* do not. They can thus describe an event, e.g., e_2, that overlaps the state of wearing red.

In fact, Altshuler's original example in (2) motivating forward-shifting has the same kind of "long-distance" strategy of inquiry. This is more clear once the broader context for the *now* sentence is considered:

(44) Fearing for my life, I murdered my unfortunate victim in an ordinary and crude manner. As **I returned to this fire-ravaged area night after night to ascertain whether I'd left behind any traces that might betray me**, questions of style increasingly arose in my head. What was venerated as style was nothing more than an imperfection or flaw that revealed the guilty hand.

I could've located this place even without the brilliance of the falling snow, for this spot, razed by fire, was where I'd ended the life of my companion of twenty-five years. **Now**, snow covered and erased all the clues that might have been interpreted as signature[...]

(Orhan Pamuk, *My Name is Red*)

Altshuler interprets *now* as locating the event of snow covering after the event of ending the companion's life. But it is clear from the preceding context that the question being addressed is: *When were there or weren't there still traces of the murder?* This is exactly the kind of question that the contrastive topic on *now* requires in this discourse.

To align with these examples, as well as the facts about *then* that we discussed in Section 5, we provide a revised version of the positional generalization:

(45) *Positional Generalization (final version)*
For a sentence S containing a temporal demonstrative D,

(i) if D is in initial position, S cannot temporally overlap any sentence S' with which it forms a strategy of inquiry, and

a. if D is *now*, then S temporally follows S';

b. if D is *then*, then S either temporally follows or precedes S';

(ii) if D is in final position, S is temporally "roughly simultaneous" with the closest preceding sentence S'.

Our account derives this revised generalization, predicting not just the interpretation of *now* in the simple constructed examples we started with, but also the more complex, naturally-occurring examples we have discussed here.

7. Conclusion

In this paper, we have argued that the intuition of recent change or contrast for *now* arises from a conspiracy of three distinct ingredients: the pragmatics of contrastive topic, the pragmatics of backshifting, and the semantics of this adverb, which we have analyzed as indexical to a time of assessment. Of these ingredients, we take the contrastive topic component to be the central contribution of our proposal. This is partly empirical — the positional generalization is novel and, we believe, problematic for existing theories of *now*. But we also believe that the positional generalization is reflective of the role of information structure in narrative sequencing in general, something currently missing across all these theories.

This point is probably best made by considering in more detail the other accounts of *now*. There are three main theories of its semantics. In place of an indexical time coordinate, these theories make *now* sensitive to an antecedent event (Altshuler, 2016: 13–59, Carter and Altshuler, 2017), a temporal perspective point (Kamp and Reyle, 1993; Lee, 2017), or discourse coherence relations (Hunter, 2011).

We have already seen how the first account behaves: *now* presupposes some culminated event and asserts that the prejacent is in the final or result state of that event. At a conceptual level, this account combines the two properties we have attempted to decouple (contrast and temporal orientation). Empirically, this means that the simultaneous interpretation of *now* in final position is somewhat mysterious, unless a salient event can be accommodated farther back in the discourse. However, it is not clear that such a salient event is always present. In (46), for instance, no event needs to have transpired between s_1 and s_2.

(46) When he was a child, Ivan was sweet^{s_1}. **Now**, he was mean-spirited^{s_2}.

Our account resembles the other two theories of *now* more closely. In one, due originally to Kamp and Reyle (1993), *now* picks out a temporal perspective point, TPpt. Lee (2017) fleshes out their account, requiring TPpt in narratives to be updated with each new telic event that is introduced in the discourse to a time following it (analogous to what is supposed to happen in narrative progression). While this account bears an obvious resemblance to ours — replacing TPpt for both $\textsc{time}(a)$ and the *now*-interval — Lee's constraint is too strict. First, it does not explain why stative eventualities with initial *now* should allow forward-shifting interpretations, since TPpt is only updated by telic events. Conversely, it predicts that a telic sentence containing *now* should always temporally follow the most recent telic sentence. But, contrary to Lee's account, a simultaneous interpretation is possible, as predicated by our account, in an elaboration context:

(47) Whenever he used to go to a restaurant, Max would avoid all kinds of seafood. Recently, he got over his fear. He had^{e_1} a nice meal last night.

a. **Now**, he ordered^{e_2} the salmon. $e_1 \supset e_2$

b. He ordered^{e_2} the salmon **now**. $e_1 \supset e_2$

In the third theory, which makes *now* sensitive to discourse coherence relations, Hunter (2011) proposes that it picks out the time of the immediately dominating discourse unit. In narrative sequences, where sentences are connected by a coordinating Narration relation, this is a superordinate unit expressing a "common topic", so that *now* picks out the temporal interval for that common topic, and hence an interval containing the entire narrative sequence. Like the TPpt approaches, this account is actually quite congenial with ours, interchanging the assessment time and the time of the immediately dominating discourse segment. However, because discourse relations determine the temporal structure between sentences, this account is ultimately more flexible than Lee's. For instance, since elaboration relations are subordinating, the superordinate discourse unit in (47) describes e_1, and hence *now* denotes the run time of e_1, allowing a simultaneous interpretation for telics.

All of this means that, while neither of these latter two theories derives the positional generalization, Hunter's is, in principle, compatible with a role for contrastive topic (while Lee's, we believe, overpredicts). Indeed, finding a place for information structure could greatly simplify theories of discourse coherence relations. While Asher and Lascarides (2003), for instance, initially propose that Narration temporally positions one sentence immediately after another, they are forced to stipulate that a sentence-initial temporal adverbials can shift the time of a sentence even farther into the future. If these initial adverbials are all functioning as contrastive topics, it may be this information-structural category instead that is responsible for obviating a more restrictive notion of immediate subsequence.

Despite some resemblances, our account of *now* does differ from the last two theories we just considered in one significant way. We have argued for a distinction between the *now*-interval and the assessment time, while in both Hunter's and Lee's accounts, these intervals are collapsed. The merits and concerns of this additional degree of freedom that we avail ourselves clearly need more rigorous examination, but we leave this task to future work.

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Tomorrow isn't always a day away[1]

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Abstract. This paper explores non-utterance time readings of *tomorrow*, which, though unexpected under the standard pure indexical view of *tomorrow*, are attested in American English: e.g., "Last week, UPS said that the package would be delivered tomorrow." This example has two readings: an utterance time reading, which can be felicitously followed by "I hope it arrives on time!", and a non-utterance time reading, which can be followed by "But it never showed up!" I present experimental evidence that (1) non-utterance time readings of *tomorrow* are acceptable for many American English speakers and (2) not due to Free Indirect Discourse or indexical shift. Instead, I propose an analysis of *tomorrow* as anaphoric to a salient perspective.

Keywords: temporal adverbials, context sensitivity, experimental semantics, perspective.

1. Introduction

Indexicality and anaphoricity are two types of context sensitivity. Indexicals refer relative to the context of utterance, while anaphoric reference is relative to discourse-given referents. While some expressions are purely indexical or purely anaphoric, a growing number of expressions have been found to have both anaphoric and indexical uses. In some cases, anaphoric uses have been miscategorized as indexical uses because the referent is something complex, like a result state in the case of the temporal indexical *now* (Altshuler and Stojnić, 2015).

One case where anaphoric reference is particularly difficult to distinguish from indexicality is perspective-anaphoric expressions. For instance, although *come* has been analyzed as indexical (Oshima, 2006), Barlew (2017) has argued convincingly that it is in fact anaphoric to salient perspectives. Its anaphoricity had been overlooked because the speaker and addressee's utterance-time perspectives are always salient, leading to an indexicality illusion.

I argue that *tomorrow*, long thought to be a pure indexical (Kamp, 1971; Kaplan, 1989), is in fact anaphoric to perspectives. Because the salient perspective is so often the speaker's, and the speaker's perspective is so often the same as the utterance context, *tomorrow*'s perspectival nature has been obscured by its identical behavior to pure indexicals in most environments. I explore the interpretation of *tomorrow* in environments in which the salient perspective is not an utterance-time perspective, and show that its behavior is not consistent with pure indexicality. The data that I consider are non-utterance (non-UT) time readings of *tomorrow*, as in (1).

(1) Two weeks ago, Jane said that the package would arrive tomorrow, but it never came.

This sentence does not make sense if *tomorrow* is interpreted as the day after utterance time; if it is judged felicitous, *tomorrow* must refer to the day after the saying event. Although such readings have been reported to be ungrammatical, they are easily found in corpus data, and I present experimental evidence that they are accepted by many American English speakers.

The existence of non-UT readings does not disprove that *tomorrow* is a pure indexical, since non-UT indexical readings can arise if the context parameter has been manipulated, such as in

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Free Indirect Discourse (FID) or indexical shift. In order to investigate non-UT interpretations of *tomorrow*, I present a series of studies that narrow the hypothesis space for such readings, considering three main possibilities: that non-UT readings of *tomorrow* arise from FID effects; that they are like indexical shift reported in other languages (Schlenker, 2003); or that they are anaphoric.

I establish a baseline of acceptability for non-UT readings through a sentence acceptability judgment task, and then test the predictions that the FID and indexical shift accounts make about pronoun use and embedding under attitude verbs. On the basis of the results, I argue that non-UT readings are not indexical; however, on the basis of quantificational binding data, I also argue that *tomorrow* is not anaphoric to just any time. I posit instead that *tomorrow* can be anaphoric to salient perspectives, and that this behavior has been overlooked because the salient perspective is almost always identical to the context of utterance.

This suggests that perspective may play a role in the interpretation of more expressions than previously thought, highlighting the need to explore whether context-sensitive items like shifty indexicals are also sensitive to perspective. In addition, this work reveals a temporal parallel to perspective-anaphoric expressions in the spatial domain like the motion verb *come*.

2. Analyzing non-utterance time *tomorrow*

A central question about non-UT interpretations of *tomorrow* is whether they are indexical or anaphoric. An expression is used *indexically* when it refers relative to the context parameter of the sentence; it is used *anaphorically* when it refers relative to a reference point given by the discourse context. In addition, Kaplan (1989) defines a class of *pure indexicals*, expressions whose interpretation is always indexical.

In Kaplan (1989), *tomorrow* is described a pure indexical, which makes non-UT interpretations surprising unless they occur only when the context parameter has been manipulated in some way. Alternatively, these uses of *tomorrow* may be anaphoric, in which case *tomorrow* is not a pure indexical.[2] We can distinguish two types of analyses for *tomorrow*: indexical accounts, which maintain the pure indexical status of *tomorrow*, and anaphoric accounts, which posit that non-UT readings arise through anaphoric reference.

I explore two analyses that could maintain the pure indexical status of *tomorrow*: a Free Indirect Discourse account, and an indexical shift account.

2.1. Analysis 1: non-utterance time readings are due to Free Indirect Discourse effects

Temporal adverbials like *tomorrow* are known to have non-UT interpretations in Free Indirect Discourse, a literary style in which tense and person pronouns are used relative to the narrator's perspective, while temporal and locative indexicals, expressives, and perspectival items like deictic motion verbs are used relative to the protagonist's perspective. In FID, temporal adverbials refer relative to the protagonist's *now*, which is event time (ET), rather than the narrator's, which is utterance time (UT).

[2]There are views of modeling context in which anaphoric expressions are treated as pure indexicals (Stojnić, 2016).

Most analyses of FID maintain the pure indexical status of protagonist-oriented indexicals. Rather than changing the lexical semantics of such expressions, they propose a modification of Kaplanian contexts. For instance, Eckardt (2014), building on Doron (1991)[3] proposes that there are two types of context parameters: the external context parameter *C*, representing the narrator's utterance situation, and an internal context parameter *c*, representing the protagonist's thought situation. In direct speech, only the external context is available, but FID makes an internal context available. When there are two context parameters, shiftable indexicals refer relative to the internal context, while rigid indexicals remain fixed to the external context.

This account posits that non-UT readings arise when *tomorrow* is interpreted relative to an internal context. The FID account, and others that use multiple context parameters or context-overwriting, is consistent with a pure indexical view of *tomorrow*, since even when receiving protagonist-oriented interpretation, *tomorrow* would refer to a context parameter.

A FID view of non-UT *tomorrow* makes several predictions. First, we would expect that other items that are protagonist-oriented in FID contexts would receive non-UT interpretations in the same contexts as *tomorrow*. We would expect uniform behavior across temporal and locative indexicals and expressives in contexts where non-UT interpretations of *tomorrow* occur.

Second, non-UT interpretations of *tomorrow* would not need to be embedded under a speech verb, since FID often does not involve an explicit speech or attitude verb.

Third, the FID explanation predicts that non-UT readings should not be possible in narrator-oriented clauses, in other words, clauses where a first-person subject is reporting their own thoughts. First-person pronouns in FID always refer back to the narrator, rather than the protagonist, and the narrator's time is utterance time (Banfield, 1982).

2.2. Analysis 2: *tomorrow* is a shifty indexical

Another analysis consistent with a pure indexical view of *tomorrow* is that non-UT interpretations of *tomorrow* are due to indexical shift. Indexical shift is a phenomena found in many languages in which indexicals embedded under a speech or attitude verb are interpreted relative to the embedded context rather than the matrix context.[4]

In the Korean example in (2), for example, *nayil* 'tomorrow' can refer either to the day after utterance time (matrix interpretation), or the day after Mary's speech act (shifted interpretation).

(2) Context: It is January 8th.

cinan	cwu-ey	Mary-ka	nwuka	nayil	ttenanta-ko	malhayss-ni?
last	week-in	Mary-NOM	who-NOM	tomorrow	leave-C	said-Q

'Who did Mary say a week ago would leave on January 2nd/9th?' (Park, 2018)

The dominant analysis of indexical shift posits a covert syntactic operator that can shift the context parameter in speech-embedding environments (Schlenker, 1999; Anand and Nevins, 2014; Deal, 2014). Under such analyses, the indexicals involved are still considered pure indexicals, because they are evaluated relative to a context parameter. Supporting evidence for

[3]I present the analysis from Eckardt (2014) because it is one of the most complete treatments of temporal phenomena, but see Schlenker (2004), Sharvit (2008), and Maier (2015) for other analyses.

[4]For a list of languages with shifty indexicals and a more in-depth discussion of the phenomena, see Deal (2017).

this treatment comes from the fact that shifty indexicals do not allow quantificational binding.

One plausible explanation for non-UT interpretations of *tomorrow*, then, is that they are instances of indexical shift. If this is the case, *tomorrow* may still be a pure indexical, since the dominant analyses of indexical shift posit that the original context parameter is overwritten by a context parameter representing the embedded speech context. The lexical semantics of *tomorrow* do not need to change: non-UT interpretations are created by a covert shift operator that manipulates the temporal parameter of the context tuple.

This account predicts that *tomorrow* should be infelicitous in quantificational binding environments, as reported for other shifty indexicals. In addition, it predicts that non-UT interpretations should only arise when *tomorrow* is embedded under a speech or attitude verb.

2.3. Analysis 3: *tomorrow* is anaphoric

If neither of the two accounts sketched above capture the behavior of *tomorrow*, then perhaps *tomorrow* is not a pure indexical, and its non-UT uses are anaphoric. Saying that non-UT interpretations of *tomorrow* are anaphoric is only a partial account, since in order to understand such readings, we also need to know what kind of object *tomorrow* can be anaphoric to. As work on *now* highlights, seemingly temporal expressions are not always anaphoric to any salient time in the discourse context; they may be anaphoric to something more complex, such as a result state (Altshuler and Stojnić, 2015; Altshuler, ming). Even if *tomorrow* has anaphoric uses, therefore, it may not be able to take any salient time as its reference time. For now, I set aside this question and sketch out the predictions that all anaphoric accounts make.

First, an anaphoric account predicts that non-UT readings could arise even when there is no manipulation of the context parameter as there is in FID or indexical shift. Because of this, an embedding speech verb is not predicted to be obligatory.

Second, the anaphoric account does not necessarily predict that other indexicals will behave similarly in the same contexts, since it posits a different lexical semantics for *tomorrow*, one that allows anaphoric selection of reference times. We might expect *tomorrow* to behave similarly to *the next day*, since *the next day* is also anaphoric; however, if *tomorrow* is anaphoric to a different kind of referent, this will not necessarily be the case.

2.4. Evaluating analyses of non-utterance time *tomorrow*

I have outlined three kinds of analyses for non-UT *tomorrow*: two consistent with pure indexicality, and one that takes an anaphoric approach. These accounts make different predictions about the availability of non-UT readings in a number of environments, summarized in Fig. 1.

Table 1: Overlap of analysis predictions

Subject	Unembedded	Embedded
1st-person		Indexical
2nd-person		shift
3rd-person	FID	

Indexical shift hypothesis =
Anaphoric hypothesis =
FID hypothesis =

Using experimental methods, we can evaluate these accounts by testing the availability of non-UT readings in contexts for which their predictions differ. In Experiment 1, I establish a baseline of acceptability of non-UT *tomorrow*. In Experiments 2 and 3, I test the predictions of the indexical accounts by manipulating the environment in which *tomorrow* occurs. Last, I report results from a debriefing task that bears upon the anaphoric hypothesis.

3. Experiment 1: establishing a baseline

Experiment 1 establishes a baseline of acceptability for non-UT interpretations of *tomorrow*. The grammatical environment used is one that all three analyses predict should license non-UT readings of *tomorrow*: embedding under a speech verb with a third-person subject.

3.1. Method

Data on the acceptability of non-UT interpretations of *tomorrow* in American English was collected through a comic-captioning task where participants rated captions for three-panel comic strips on a 7-point Likert scale (where 7 indicates high naturalness). Ratings for *tomorrow* were compared against the anaphoric expression *the next day* and a factually correct and factually incorrect baseline; we expect true captions to receive higher ratings than false captions. If participants rate the *tomorrow* items higher than the false baseline and close to *the next day*, then we confirm that non-UT readings of *tomorrow* are possible.

3.1.1. Participants

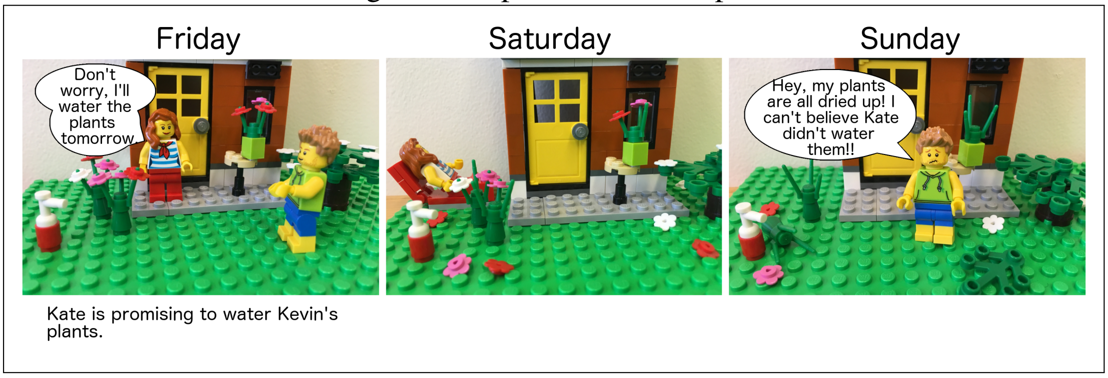
126 participants were recruited through Amazon's Mechanical Turk platform. 4 participants were excluded because English was not the language of their childhood household; 50 participants were removed because their mean ratings for the good baseline condition were not at least 1 point higher than for the bad baseline.[5] This left 72 participants. These exclusion criteria were preregistered through the Open Science Foundation.

3.1.2. Materials

20 critical items were developed and distributed across four Latin Squared lists. Each list was combined with the same set of 10 fillers. Each item included a comic strip and a sentence below it (Fig. 1). In the comic's first panel, one character promises to do something the following day. Nothing happens in the second panel, indicating that they did not follow through. In the third panel, the other character expresses frustration. Participants were asked to judge the sentence as a caption for the third panel.

[5]This high rate may be due to the fact that there was no training item that required participants to read the day-of-week labels for the comics.

Figure 1: Experiment 1 example stimulus



Kevin is angry because Kate said that she would water his plants $\left\{\begin{array}{l}\text{tomorrow}\\ \text{the next day}\\ \text{Friday}\\ \text{Saturday}\end{array}\right\}$.

Four conditions were created by manipulating the final temporal expression in the caption: *tomorrow*, the critical condition; *the next day*, the anaphoric condition; the day of week name of the first panel, a factually incorrect baseline; and the day of week name of the second panel, a factually correct baseline. Whether or not speakers allow non-UT readings of *tomorrow*, they were expected to interpret the *tomorrow* in the first panel as referring to the second day shown in the panel. The captions containing *tomorrow* are felicitous only if *tomorrow* is given a non-UT reading, since the first character promises to do the action on the second day depicted by the comic, and the other character would not have grounds for anger on the UT reading.

Table 2: Experiment 1 predictions

Temporal expression	Truth	Predicted ratings
False control	False	Low
True control	True	High
the next day	True	High
tomorrow	If participant allows non-UT reading, True	High
	If not, False	Low

Three kinds of fillers were used: bad fillers, which had captions that were obviously incorrect; good fillers, which had captions that were correct and required no temporal reference; and medium fillers, which were factually correct, but under- or over-informative.

We also collected basic demographic information about the participants, in order to explore whether any sociolinguistic factors such as age or geographic location affected their ratings; none of these factors were found to be informative, so discussion of them will be omitted.

3.1.3. Procedure

Stimuli were displayed and responses collected using the Ibex platform for web-based experiments. Each experimental session began with an informed consent form and a demographic survey. Next, participants read that they would see a comic strip with a sentence below it and be asked to rate the acceptability of the sentence as a caption for the third panel of the comic. Participants were given 3 items in order to train them in scale use: a true item, which they were told most participants would rate at 7; a false item, which they were told most participants would rate at 1; and a medium filler, which they were told most participants would rate at 4.

3.1.4. Regression analysis

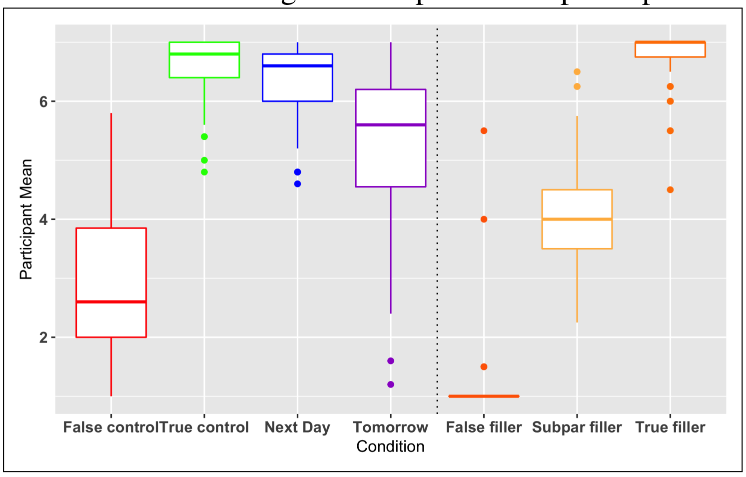
An analysis using paired t-tests was preregistered, but after discussion with colleagues, we decided to use a mixed effects ordinal regression model.[6] The maximal random effects structure was used for all models: we included random intercepts and slopes for all fixed-effects predictors, for participants, and for items. Treatment coding was used, treating *tomorrow* as the baseline condition. This resulted in the following fixed-effects contrasts: *tomorrow*, 1 for *tomorrow* and 0 otherwise; *the next day*, 1 for *the next day* and 0 otherwise; false control, 1 for the false control and 0 otherwise; and true control, 1 for the true control and 0 otherwise.

In addition to the model described above, we ran a model that included the pragmatically suboptimal fillers as a fixed-effect predictor, in order to compare the ratings for these fillers to the *tomorrow* condition. This comparison was not preregistered.

3.2. Results

The results showed that participants rated the *tomorrow* items much higher than the false baseline items, but somewhat lower than the true baseline and *the next day* items (Table 3).

Figure 2: Experiment 1 participant means by condition



[6]The comparisons of interest were the same under both analyses.

Table 3: Experiment 1 results

Condition	Mean ratings	95%CI
False control	2.9	2.6-3.2
Tomorrow	5.3	5.0-5.6
The next day	6.4	6.2-6.5
True control	6.6	6.5-6.7
Bad fillers	1.1	0.9-1.3
Medium fillers	4.0	3.8-4.2
Good fillers	6.8	6.7-6.7

In the regression analysis, all three coefficients were reliable effects at $p < 0.00001$. This shows that the ratings in the *tomorrow* condition were significantly different from the false baseline, but also from *the next day*. Participants accept non-UT readings of *tomorrow*, but to a lesser degree than *the next day*.

Table 4: Experiment 1 mixed effects regression analysis, fixed effects (N=1440)

	$\hat{\beta}$	z	p
False control	-3.36(+/- 0.36)	-9.3	< 0.00001
True control	2.47(+/- 0.38)	6.45	<0.00001
next day	1.53(+/- 0.29)	5.35	<0.00001

We might ask whether *tomorrow* items have high ratings not because they are grammatical, but because they can be accommodated through semantic coercion. The ratings of the pragmatically sub-optimal fillers suggest otherwise; participants rate the *tomorrow* items more highly than these items, which required a small amount of accommodation in order to fit the context.

To test whether the *tomorrow* scores were significantly different from those of the pragmatically subpar fillers, a second regression model that included the medium fillers was run.

Table 5: Experiment 1 mixed effects regression analysis including medium fillers, fixed effects (N=1728)

	$\hat{\beta}$	z	p
False control	-2.78(+/- 0.29)	-9.5	< 0.00001
True control	2.25(+/- 0.33)	6.74	<0.00001
next day	1.34(+/- 0.25)	5.45	<0.00001
Medium fillers	-1.53(+/-0.27)	-5.59	<0.00001

The coefficient for the medium filler condition was significant, indicating that *tomorrow* is rated significantly higher than the medium fillers. The difference in ratings between the medium fillers and the *tomorrow* items provides more evidence that non-UT *tomorrow* is accepted.

3.2.1. Interspeaker variation

There is interspeaker variation in the acceptability of the non-UT *tomorrow* items. Fig. 3 shows the means for each condition by participant in order of increasing *tomorrow* means. While most mean *tomorrow* ratings group together above the scores for the bad baseline, some speaker means for *tomorrow* are just as low as the bad baseline scores. This suggests that the mean for *tomorrow* is lower than *the next day* not because all participants consistently give it medium ratings, but because there is a small group of participants who rate it very low.

Figure 3: Experiment 1 means by participant

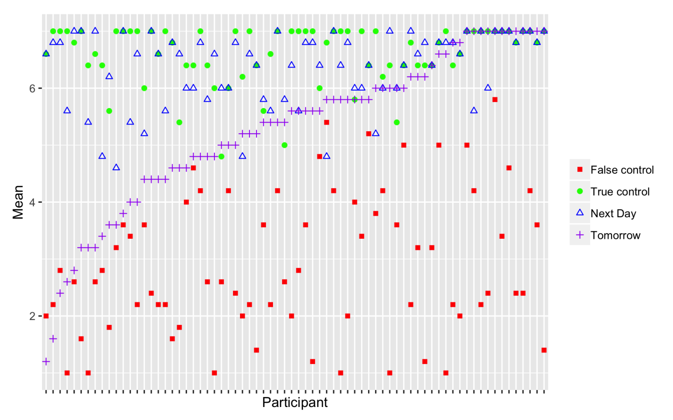


Table 6: Overlap of analysis predictions

Subject	Unembedded	Embedded
1st		Indexical shift
2nd		
3rd	FID	

Indexical shift hypothesis =
Anaphoric hypothesis =
FID hypothesis =

3.3. Discussion

Experiment 1 shows that participants rate non-UT interpretations of *tomorrow* lower than *the next day*, but well above the false control items and the pragmatically subpar fillers, establishing that non-UT readings of *tomorrow* are accepted by a large group of American English speakers.

Having established this baseline of acceptability, I turn to evaluating the three analyses outlined in Section 2 (Fig. 5). Experiment 2 manipulates pronoun use to explore whether non-UT interpretations of *tomorrow* can be explained by FID effects.

4. Experiment 2: exploring Free Indirect Discourse as an analysis

One hypothesis about non-UT readings of *tomorrow* is that they arise from FID effects. Experiment 2 tests this hypothesis using first-person narration, which, as discussed in Section 2.1, blocks protagonist-oriented readings. If participants rate *tomorrow* items comparably in Experiment 1 and 2, the non-UT readings are not due to FID effects alone.

4.1. Methods

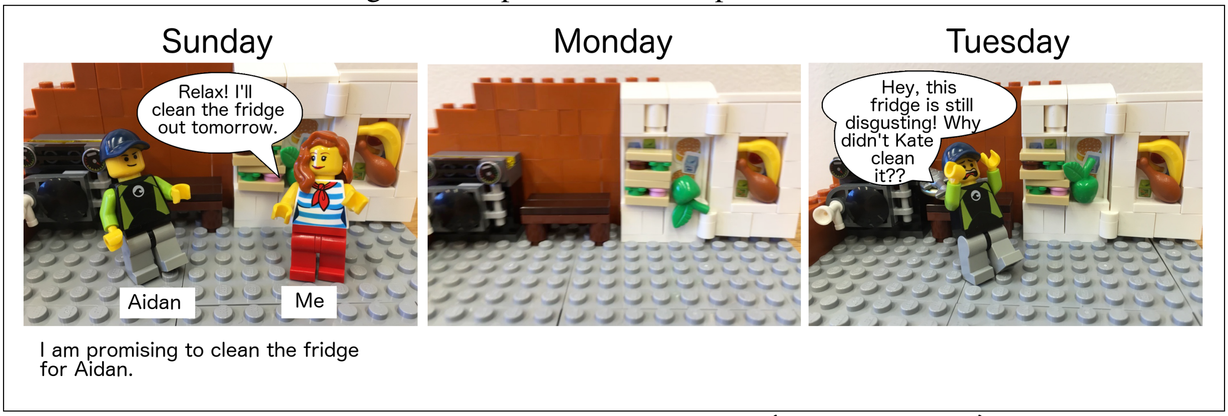
52 participants were recruited through Amazon Mechanical Turk.[7] 4 failed to meet the inclusion criteria and were removed, leaving 48 participants balanced across experimental lists.[8]

[7] Analysis of the effect size from Experiment 1 suggested that the number of participants could be reduced.
[8] A training item was added that highlighted the day-of-week labels, reducing the participant removal rate.

The stimuli and fillers from Experiment 1 were modified to use first-person narration: captions were changed to use first-person pronouns, and the promiser was labeled as the narrator (Fig. 4).

The experimental procedure was as in Experiment 1, except that participants were instructed that each comic represented a diary written by one of the characters on the day it describes.

Figure 4: Experiment 2 example stimulus



Aidan is angry because I said that I would clean the fridge $\left\{\begin{array}{l}\text{tomorrow}\\ \text{the next day}\\ \text{Sunday}\\ \text{Monday}\end{array}\right\}$.

4.2. Results

The results of Experiment 2 were very similar to Experiment 1. Participants rated the *tomorrow* items lower than *the next day*, but above the pragmatically suboptimal fillers, the false fillers, and the false control items (Table 7). As in Experiment 1, there was a small group of participants who gave *tomorrow* items low ratings, but the majority gave high ratings to *tomorrow* items.

Table 7: Participant means by condition for Experiment 1 and Experiment 2

Condition	Experiment 1	Experiment 2
False control	2.9	2.2
Tomorrow	5.3	5.6
The next day	6.4	6.5
True control	6.6	6.6

A mixed-effects ordinal regression model was run to compare Experiment 1 and 2; the Experiment 2 coefficient was not significant, indicating that *tomorrow* scores did not differ significantly.

4.3. Discussion

Experiment 2 replicated Experiment 1. There was no significant difference between the *tomorrow* ratings in the two experiments. Contrary to the predictions of the FID account, participants rated the *tomorrow* items with first-person subjects similarly to the Experiment 1 items. This suggests that non-UT interpretations of *tomorrow* are not limited to FID contexts.

Neither Experiment 1 or Experiment 2 provide evidence for or against the other two hypotheses: the indexical shift and the anaphoric accounts. Experiment 3 tests the predictions of the indexical shift account.

Figure 5: Attested pattern of non-UT *tomorrow*

Subject	Unembedded	Embedded
1st-person 2nd-person		✓
3rd-person		✓

Indexical shift hypothesis =
Anaphoric hypothesis =
FID hypothesis =

5. Experiment 3: testing the indexical shift account

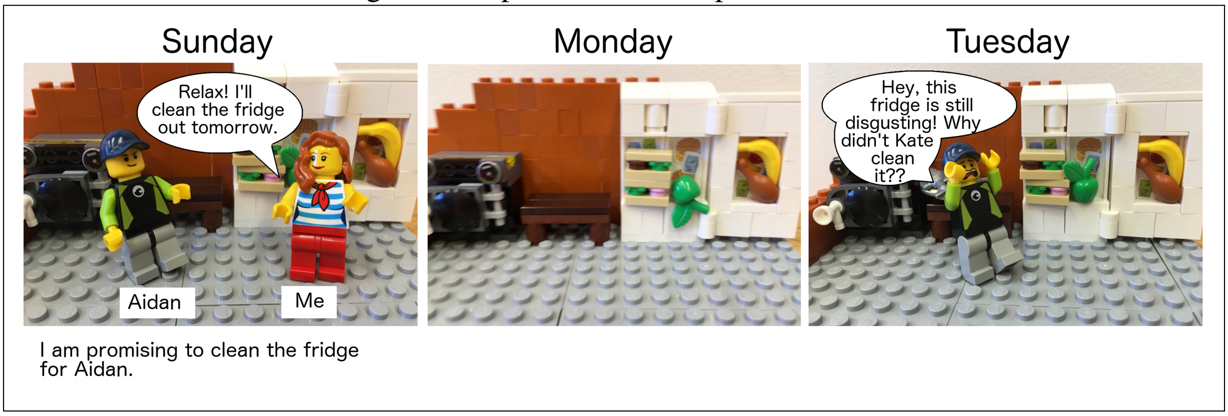
Experiment 1 showed that non-UT readings of *tomorrow* are possible under speech-verb embedding. Experiment 3 tests whether such embedding is necessary, as predicted by the indexical shift account. In Experiment 3, we remove the embedding verb from the critical sentences. The indexical shift account predicts that non-UT readings should not arise in this context, because the context parameter has not been shifted. Anaphoric accounts, by contrast, predict that this should not affect the availability of non-UT readings, so long as a non-UT perspective is salient.

If the results show that non-UT readings of *tomorrow* do not arise, it will be strong evidence in favor of an indexical shift account. On the other hand, if the results show that such readings arise in unembedded contexts, the anaphoric account will be the most promising, since we will have evidence against the two pure indexicality-consistent accounts.

5.1. Methods

53 participants were recruited through Amazon Mechanical Turk. 5 failed to meet the exclusion criteria and were removed, leaving 48 participants balanced across experimental lists. The same experimental methods were used as in Experiment 1 and 2, but the embedding speech verbs were removed from the captions. To provide a salient previous time, the conversation between the characters is mentioned in the caption, but without an embedding speech verb (Fig. 6).

Figure 6: Experiment 3 example stimulus



It was such a simple task to clean the fridge $\left\{\begin{array}{l}\text{tomorrow}\\ \text{the next day}\\ \text{Friday}\\ \text{Saturday}\end{array}\right\}$! I can't believe I forgot.

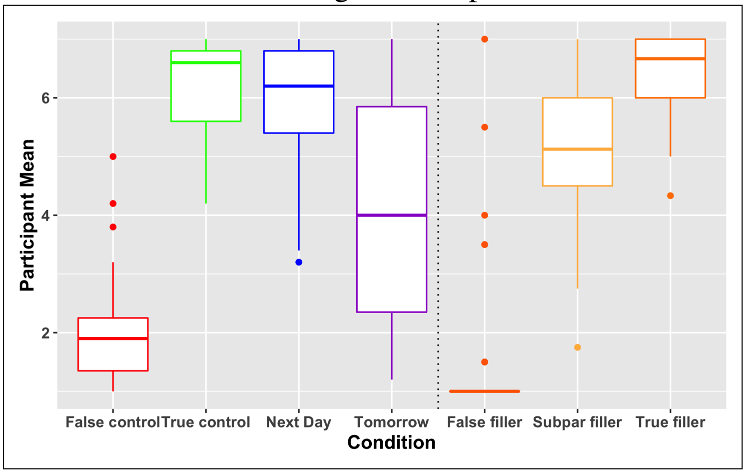
5.2. Results

The mean ratings for *tomorrow* items were lower than in previous experiments, but still significantly higher than the false control items and the false fillers. The true controls, the false controls, the true fillers, *the next day*, and *tomorrow* were all rated lower than in previous experiments. The medium fillers and the false fillers were rated higher than in previous experiments.

Table 8: Comparison of mean ratings across experiments

Condition	Experiment 1	Experiment 2	Experiment 3
False control	2.9	2.2	2.1
Tomorrow	5.3	5.6	4.1
The next day	6.4	6.5	5.9
True control	6.6	6.6	6.3
False fillers	1.1	1.2	1.4
Medium fillers	4.0	3.9	5.0
True fillers	6.8	6.7	6.4

Figure 7: Experiment 3 main condition ratings



In the mixed-effects ordinal regression model, all three coefficients were reliable effects at $p < 0.00001$. Thus, despite the lower *tomorrow* scores in this experiment, the *tomorrow* condition was still significantly different than the false control condition.

Table 9: Experiment 3 mixed effects regression analysis, fixed effects (N=960)

	$\hat{\beta}$	z	p
False control	-3.41(+/- 0.50)	-6.81	< 0.00001
True control	3.20(+/- 0.48)	6.63	<0.00001
next day	2.54(+/- 0.50)	5.08	<0.00001

Although the main comparisons in Experiment 3 were similar to Experiment 2, a mixed-effects ordinal regression model comparing Experiment 1 and 3 finds significant interactions between experiment and *tomorrow* and between experiment and *the next day*, indicating that the differences between the Experiment 1 and Experiment 3 ratings for the *tomorrow* and *the next day* conditions were significant.

Table 10: Experiment 1 and Experiment 3 comparison mixed-effects regression analysis, fixed effects and interactions (N=2400)

Condition	$\hat{\beta}$	z	p
False control	-3.44(+/-0.36)	-9.44	< 0.00001
True control	2.31(+/-0.36)	6.47	<0.00001
the next day	1.50(+/-0.33)	4.52	<0.00001
Experiment 2	-1.72(+/-0.47)	-3.6	0.0002
False control * Experiment 2	0.35(+/-0.53)	0.65	0.52
True control * Experiment 2	0.87(+/-0.52)	1.68	0.09
the next day * Experiment 2	0.97(+/-0.47)	2.06	0.039

The 95% confidence intervals for participant means were wider than in Experiment 1 and 2; for *tomorrow* items, the 95% CI was larger than 1 Likert scale point.

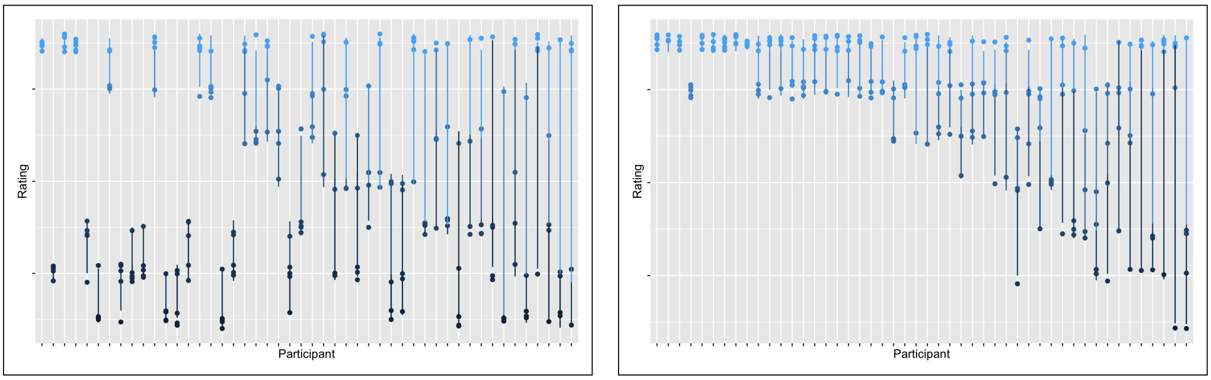
Table 11: Experiment 3 results

Condition	Mean rating	95%CI for part. means
False control	2.1	1.8-2.3
Tomorrow	4.1	3.5-4.6
The next day	5.9	5.6-6.2
True control	6.3	6.1-6.5
Bad fillers	1.4	3.9-5.4
Medium fillers	5.0	4.7-5.4
Good fillers	6.4	6.3-6.6

5.2.1. Interspeaker variation

There was a higher amount of interspeaker variation in *tomorrow* ratings in this experiment, along with greater variance in ratings for other conditions. The distribution of *tomorrow* scores in Experiment 3 is almost bimodal: one group of participants rates *tomorrow* near *the next day*, while another group rates it near the bad baseline. In Fig. 8, which plots *tomorrow* ratings by participant, some participants have scores clustered at the bottom, and others have them clustered at the top. Both groups occasionally give a rating at the opposite end of the scale (shown by a long line connecting the participant's lowest and highest ratings).

Figure 8: Experiment 3 *tomorrow* ratings (left) and *the next day* ratings (right) by participant, in order of increasing difference between highest and lowest rating



The question is whether the participants who give *tomorrow* low ratings in this experiment are the same as those in Experiment 1 and 2. It may be that Experiment 3 sampled more heavily from this population; or it may be that removing the embedding verb has a real effect on the acceptability, and that these participants would have accepted the *tomorrow* items in Experiment 1 and 2.

5.3. Discussion

Ratings for *tomorrow* items were lower in Experiment 3 than in previous experiments. They were not significantly different than the ratings for the pragmatically sub-optimal fillers, though they were still significantly above the bad baseline. In addition, there was more interspeaker variation in *tomorrow* ratings than in previous experiments.

The lower *tomorrow* ratings are problematic. One possibility is that Experiment 3 sampled more heavily from the speaker group that does not ever accept non-UT readings of *tomorrow*. Another (non-exclusive) explanation is that *tomorrow* is anaphoric, but to something more difficult to process than a simple time. This could explain why *tomorrow* is rated lower than *the next day*, and, if the attitude verb facilitates the anaphora resolution, why the ratings are lower in Experiment 3.

Figure 9: Attested pattern of non-UT *tomorrow*

Subject	Unembedded	Embedded
1st-person 2nd-person	✓	✓
3rd-person		✓

Indexical shift hypothesis =
Anaphoric hypothesis =
FID hypothesis =

Although one group of participants gave the *tomorrow* items mostly low ratings, a substantial group gave them consistently high ratings. These results argue against an indexical shift account, since it predicts that non-UT *tomorrow* should never occur outside of embedding. I proceed with an analysis of *tomorrow* that focuses on the group of speakers who accept *tomorrow* in Experiment 3, since the results suggest that for a substantial group of speakers, non-UT readings of *tomorrow* are possible in non-embedded contexts.

6. Anaphoric accounts of *tomorrow*

Experiments 1, 2, and 3 test the predictions of three accounts: the FID account, the indexical shift account, and the anaphoric account. Experiment 2 showed that contrary to the FID account, non-UT interpretations of *tomorrow* occur in narrator-anchored environments. Experiment 3 showed that unlike indexical shift, they also occur outside of embedded contexts for one group of speakers. Under these accounts, *tomorrow* could be a pure indexical; their failure suggests that non-UT readings are anaphoric, and *tomorrow* is not a pure indexical. However, this is a partial account: we also need to determine to what kind of referent *tomorrow* can refer.

6.1. Is *tomorrow* anaphoric to salient times?

Pure indexicals are infelicitous in quantificational binding contexts, because their referent does not covary with the quantifier (as it is fixed to the utterance context). Anaphoric expressions, on the other hand, can appear in quantificational binding contexts so long as there is a salient referent for them that covaries with the quantifier. The anaphoric expression *the next day* is felicitous in (3), because the quantification over time provides a salient referent.

(3) Whenever I wash my car, it rains the next day.

Since *tomorrow* is a temporal expression, an intuitive anaphoric account is that it is anaphoric to a salient time in the preceding discourse: *tomorrow* is akin to *the next day*, except that *tomorrow* allows indexical interpretations. This account predicts that anaphoric uses of *tomorrow* should be possible in quantificational binding contexts where times are quantified over.

However, this account is not the only possible anaphoric account. As work on *now* has illustrated (Altshuler and Stojnić, 2015; Altshuler, ming), temporal expressions are not necessarily anaphoric to any salient time in the discourse context. Moreover, the fact that *tomorrow* items received lower ratings than *the next day* suggests that they do not pattern exactly alike.

6.1.1. Evaluating the time anaphoric account

The prediction that *tomorrow* should be felicitous under quantification over times was tested in a postexperiment task following Experiment 2. The task measured acceptability of *tomorrow* in two quantificational binding contexts: quantification over times (4) and over speech contexts (5).

(4) Every time { I/Kevin } wash my car, it rains { tomorrow/the next day }.

(5) Every time the UPS person says that { my/the } package has been delivered, it doesn't show up until { tomorrow/the next day }.

Participants rated 1 time quantification item and 2 speech-context quantification items in each of the 4 conditions produced by crossing temporal adverbial (*tomorrow* or *the next day*) with person (1st or 3rd), for a total of 12 items, presented using a Latin squared design.

6.1.2. Results

Quantificationally bound *tomorrow* items received low ratings in all conditions. An ANOVA of the *tomorrow* items shows no significant difference by condition (0.55(3,188)= 0.67; p > 0.05).

Table 12: Experiment 2 binding task results

Condition	Mean *tomorrow* scores [95%CI for part. means]	Mean *next day* scores [95%CI for part. means]
Embedded 1st-person	2.7 [2.3-3.0]	5.9 [5.6-6.2]
Unembedded 1st-person	2.4 [1.8-2.9]	6.2 [5.8-6.6]
Embedded 3rd-person	2.7 [2.4-3.0]	5.8 [5.4-6.1]
Unembedded 3rd-person	2.5 [2.0-2.9]	6.1 [5.7-6.6]

This quantificational binding task disconfirms the predictions of the time-anaphoric account: *tomorrow* is not anaphoric to just any salient time in the preceding discourse.

6.2. A perspectival view of non-utterance time *tomorrow*

The experimental data suggests that for some speakers, *tomorrow* can refer anaphorically, but not to just any time. I propose that it is anaphoric to something more complex: a perspective.

6.2.1. Perspectival anaphoric reference

In proposing that *tomorrow* is anaphoric to salient perspectives, I draw upon Barlew (2017)'s analysis of deictic motion verbs as anaphoric to salient perspectives. The motion verb *come* can refer relative to the speaker's location at UT; to the speaker's location at ET (6); to the addressee's location at UT or ET; or to that of an attitude-holder (7).

(6) Context: Speaker is currently in her office.
When I got to the bar it was empty, but by the time Mark came, it was buzzing.

(7) Susan said to come there when we're done.

Working in a dynamic semantics framework, Barlew (2017) proposes that *come* presupposes that a salient perspective-holder in the Common Ground is located at the destination of motion. He notes that an indexical analysis of *come* is ruled out by the fact that *come* can appear in quantificational binding contexts, so long as the perspective-holder covaries with the quantifier. In (8), each instantiation of the woman provides a salient perspective as an anchor for *come*; *was glad* acts like an attitude verb in heightening the salience of each woman's perspective.

(8) Every woman was glad that her wayward child came to Christmas dinner. (Barlew, 2017: 52)

Barlew (2017) follows Roberts (2015) in taking a perspective to be a set of centered worlds: the worlds in which the agent's beliefs are true and the center is their self-ascribed location. Regardless of how perspective is formalized, his data reveals an important point: perspectives must be time-indexed in order to distinguish between the ET and UT licensing of *come*.

6.2.2. Towards a perspectival account of *tomorrow*

I propose that, like perspectival motion verbs, *tomorrow* is anaphoric to salient perspectives: it receives non-UT interpretations when it is anchored to a non-UT perspective, and UT interpretations when it is anchored to an UT perspective. In particular, I propose that *tomorrow* takes the time parameter of a salient perspective as its reference time.

This proposal captures the pattern of acceptability in the experimental data. In Experiment 1 and 2, a salient non-UT perspective is provided by the subject of the attitude verb. In Experiment 3, the event-time perspective of the narrator is made salient by focusing on the ET evaluation of the task ('such a simple task!'). If ET perspectives are less salient than attitude-verb introduced perspectives, it would explain the lower ratings for *tomorrow* in Experiment 3; the pattern could also be explained by interspeaker variation in the accessibility of ET perspectives.

Furthermore, a perspectival view of *tomorrow* explains why its anaphoric uses have been overlooked: the time-index of a perspective is often identical to that of the utterance context. It is only in cases where the perspective is an event-time perspective, or where the perspective-holder is mistaken about their temporal location (assuming perspective is *de se* as in Roberts, 2015), that temporal perspectival anaphora and (shifty) indexicals will diverge.

6.2.3. Quantificational binding revisited

So far, the experimental data is compatible with a perspectival view of *tomorrow*, but does not provide positive evidence for it. Another look at quantificational binding contexts could provide this: under the perspectival account, *tomorrow* should be felicitous under quantificational binding if the perspective covaries with the quantifier (9).

(9) On Christmas Eve, every little girl stays awake for hours wondering what she will find under the Christmas tree tomorrow morning.

First-person binding examples should also become more acceptable when the saliency of the ET perspectives is increased by additional perspectival context, such as expressives or epithets.

(10) Every time you have to kick a drunk idiot out of the bar, you get to gloat about how hungover the jerk will be tomorrow.

(11) My coworker is such a brat. Every time the jerk thinks it'll be sunny tomorrow, he calls in 'sick' and I have to cover his shift.

I find these examples somewhat better than the ones tested experimentally, but full testing of the quantificational binding examples is left for future work.

7. Conclusion

There is an emerging consensus that many expressions thought to be purely dependent on the context parameter for their meaning are not (Harris and Potts, 2009; Altshuler and Stojnić, 2015; Maier, 2017). I have argued that *tomorrow* has anaphoric uses, at least for a substantial portion of speakers, and therefore is not a pure indexical. In a series of experiments, I have shown that non-UT readings of *tomorrow* are not limited to FID environments or to attitude reports, as is indexical shift in other languages. In addition, I present quantificational binding evidence suggesting that *tomorrow* is not anaphoric to times. I argue instead that *tomorrow* is anaphoric to perspectives and that non-UT readings arise whenever the time-index of the perspective does not match that of the utterance context.

Although I have presented experimental evidence against several possible explanations, open questions remain. Future work should investigate whether *tomorrow* can appear in quantificational binding situations where the perspective covaries with the quantifier. In addition, the nature of the interspeaker variation observed across experiments merits further study, as does the question of whether other temporal adverbials, such as *yesterday*, behave similarly.

This work highlights the difficulty in differentiating between perspective shift and indexical shift. The environments in which perspectival items receive non-utterance-context interpretations overlap to a great extent with the environments in which indexical shift occurs. When instances of indexical shift are being investigated, care should be taken to test the environments in which perspective shift, but not indexical shift, is predicted to occur.

The non-UT interpretations of *tomorrow* discussed here add to the growing list of expressions that are sensitive to perspective: the temporal and spatial self-location of an agent in a world. This work suggests an elegant parallel between perspectival items in the spatial domain, like *come*, and perspectival items in the temporal domain, like *tomorrow*. By probing into seemingly exceptional uses of expressions like *tomorrow* experimentally, we can begin to understand the role of perspective and context-sensitivity in spatio-temporal reference.

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The puzzle of *Reflexive Belief Construction* in Spanish[1]

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Abstract. The Reflexive Belief Construction in Spanish, built by adjoining the reflexive pronoun *se* to the verb *creer* (*believe*), displays a puzzling interpretive behavior. When unembedded, *creerse* triggers the inference that its complement clause is false. When embedded under negation, it triggers the inference that its complement clause is true. We first argue that the negative inference in the unembedded case is not due to the *Maximize Presupposition!* principle (Heim, 1991), carving out the empirical profile of *creerse* along the way. We then explore two alternative explanations. The first is that *creerse* presupposes the falsity of its complement. The second is that *creerse* presupposes that the attitude holder is *wrongly* opinionated with respect to the embedded proposition. We argue that the first analysis fails unless it is supplemented with the *syntactic* account of neg-raising, whereas the second analysis faces empirical challenges. We leave the resolution of this dilemma to future work.

Keywords: (contra-)factivity, belief reports, neg-raising, presuppositions.

1. Introduction

What we will refer to as the Reflexive Belief Construction in Spanish, RBC for short, is built by adjoining the reflexive pronoun to the predicate *creer* (*to believe*), as in (1).[2] Note that the reflexive pronoun must agree with the subject DP and therefore in (1) it appears in its third-person, singular form.

(1) *Juan **se** cree que está lloviendo*.
Juan REFL believes that it is raining.

We will zoom in on one particular interpretive aspect of RBCs which to our knowledge has not been discussed in any detail. An utterance of (1) naturally implies, on top of the expected entailment that Juan believes that it is raining, that it is in fact not raining, (2). Our goal is to understand the nature and the origin of this inference.[3,4]

[1]We would like to thank Paul Egré, Benjamin Spector, Rachel Dudley, and the audiences at SuB 23, the Workshop on Modal and Evaluative Expressions held at SADAF (Argentina), and the 19th Szklarska Poręba Workshop.

[2]The reflexive pronoun in Spanish (and Romance languages in general) serves a variety of functions beyond its standard argumental role. In particular, the Spanish reflexive has been claimed to act as an aspectual ("telicity") operator in certain constructions (Bogard, 2006). RBCs, as discussed in this paper, have been recently categorized as involving another non-argumental use of the reflexive (Di Tullio, 2018), but their relation with other uses of the reflexive remains to be explicated.

[3]The data reported in this paper are based on introspective judgments of a number of native Argentinian and Spanish speakers. We believe the core generalizations carry over to other varieties of Spanish, excluding those in which *creerse* is not grammatical to begin with.

[4]Several recent studies focus on attitudinal predicates that show a similar "negative bias" as *creerse* (Kierstead, 2014 for *akala* in Tagalog, Hsiao, 2017 for *liah-tsun* in Taiwanese Southern Min, and Glass, 2019 for *yǐwèi* in Mandarin). We were not able to access Kierstead's article for the specifics. Comments on the differences between *creerse* and *yǐwèi* can be found in footnotes 9, 13 and 14. It appears that *creerse* and *liah-tsun* share substantial similarities, although there are at least two crucial differences (see footnotes 10 and 17), and data for a complete comparison are sorely lacking. Clearly much more detailed semantic fieldwork is required in this area.

(2) *Juan **se** cree que está lloviendo.*
'Juan REFL believes that it is raining.'
⇝ it is not raining

The observation in (2) might appear rather underwhelming. After all, what appears to be essentially the same inference is often triggered by run-of-the-mill belief reports in both Spanish (3a) and English (3b).

(3) a. *Juan cree que está lloviendo.*
⇝ it is not raining
b. Juan believes that it is raining.
⇝ it is not raining

The standard account of the inferences in (3) involves the principle *Maximize Presupposition!* (hf. MP, Heim, 1991). Accordingly, our first order of business in the next section is to argue that the inference associated with RBCs and the one triggered by regular belief reports do not exhibit the same empirical characteristics. We begin with a brief exposition of the mechanics of MP in subsection 2.1, and in subsections 2.2 to 2.4 we discuss three ways in which RBCs depart from regular belief reports. Specifically, we will argue that (a) MP-type inferences are (in a sense) relatively easy to cancel while the inferences triggered by RBCs are surprisingly robust, (b) MP-type inferences are in general epistemically weak while the inference triggered by RBCs are epistemically strong, and finally, (c) MP-type inferences project existentially from the scope of universal quantifiers whereas the inference triggered by RBCs project universally from the same environments. We conclude that the mechanism underlying the negative inference in (2) is distinct from the one responsible for (3): while MP is potentially a good candidate for the latter, it cannot be extended the former.

Having established that the inference triggered by RBCs is not due to MP, we proceed to consider alternatives. We will entertain two hypotheses, laid out in sections 3 and 4. Both hypotheses are "presuppositional" in that both locate the source of the target inference in the definedness conditions associated with RBCs. They differ about the content of this presupposition. In section 3, we explore the idea that *creerse* is "contrafactive" in the sense that it presupposes that its complement clause is false. This, we will argue in subsection 3.1, allows us to explain the differences between RBCs and regular belief reports discussed in section 2, and more. However, the peculiar interpretation of RBCs when embedded under negation will force us to take the role of neg-raising seriously. In a nutshell, while unembedded RBCs trigger the inference that their complement clause is false, when embedded under negation they trigger the inference that the complement clause is *true*.[5]

(4) *Juan no **se** cree que está lloviendo.*
'Juan doesn't REFL believe that it's raining.'
⇝ it is raining

[5]There is an interaction between the inference reported in (4) and the mood of the embedded clause. Under negation, the predicate *creer* and its reflexive variant in Spanish licenses both indicative and subjunctive moods (Quer, 2009). The inferences we are interested in arise *only* for indicative complements, not for subjunctive ones. Accordingly, we restrict the analysis to RBCs that embed indicative clauses. A similar behavior has been observed for factive and veridical predicates across Romance languages which also license both indicative and subjunctive complements under negation (Egre, 2009).

As we will argue in subsection 3.2, the contrafactivity analysis can only account for this "polarity reversal" effect under negation if it is coupled with the *syntactic* account of neg-raising (Collins and Postal, 2014).[6]

In section 4, we explore an alternative analysis with the hope that it might keep all the good predictions of the contrafactivity analysis without forcing us to commit to the syntactic account of neg-raising. Adopting Gajewski's (2007) theory of neg-raising, we stipulate that while a regular neg-raising predicate like *creer* (or *believe* in English) triggers the (soft) presupposition that the attitude-holder is opinionated with respect to the complement clause—what Gajewski, following Bartsch (1973), calls the "excluded middle presupposition"—*creerse* triggers the presupposition that the attitude-holder is *wrongly* opinionated with respect to the complement clause (we will call this the *enriched* excluded middle presupposition). While this second analysis covers much of the same ground as the first, it has two major shortcomings which are discussed in subsection 4.2. We conclude that the contrafactivity analysis, despite its reliance on the syntactic account of neg-raising, is nevertheless empirically superior and defer the future resolution of this dilemma to future work.

In section 5, we take a step back and provide a discussion of some further empirical issues. First, in subsection 5.1 we observe that RBCs can take other complements than propositional clauses. Interestingly, RBCs embed interrogative complements, but with two restrictions: only *wh*-questions can be embedded under *creerse* (to the exclusion of alternative and polar questions) and even this is only possible if *creerse* itself is embedded under negation. In subsection 5.2, we point out some differences between RBCs and their dative alternatives. Finally, in subsection 5.3, we report some preliminary evidence suggesting that the predicate *s'imaginer* in French has certain properties in common with RBCs. Section 6 concludes.

Before we move on, a cautionary note is in order. Our attempt at analyzing the interpretation of *creerse* is non-compositional in that we merely attempt to provide an analysis for *creerse* considered as a unit. Ultimately, one would want to derive the semantics of *creerse* from an independently motivated lexical entry for *creer* plus whatever assumptions are necessary regarding the "reflexivization" process that *creer* would go through to generate *creerse*. Our hope is that this paper will contribute to this ultimate goal by providing, as a necessary first step, an adequate analysis of *creerse* as a whole.

2. Why not *Maximize Presupposition!*

2.1. Background on *Maximize Presupposition!*

Maximize Presupposition! is a principle of language-use which encodes a preference for alternatives with stronger presuppositions.[7]

(5) *Maximize Presupposition!* (hf. MP): Use the alternative that has the strongest presup-

[6]It is tempting to use the data point in (4) to argue that RBCs do not behave in the same way as regular belief reports, as, for example, *John does not believe that it is raining* does not normally trigger the inference that it is, in fact, raining. However, the behavior of regular belief reports when negated *vis-à-vis* the truth/falsity of their complement is complicated both empirically and theoretically and, to our knowledge, has not been discussed in any detail.

[7]The principle is rooted in Heim (1991). See Sauerland (2008) and Schlenker (2012) for various extensions. See Percus (2006) and Chemla (2008) in particular for relevant discussion on belief reports.

position, unless this presupposition is not known to be true.[8]

As an example, consider how MP might derive the contrast in (6).

(6) John {#believes, knows} that Paris is in France.

Let us assume the toy semantics in (7). Note the only difference between *believe* and *know* is that the latter, being factive, triggers the presupposition that its complement is true.

(7) a. $[\![\text{believe}]\!]^w = \lambda P_{st}\lambda x_e.\,\textsc{Bel}_x^w(P)$
b. $[\![\text{know}]\!]^w = \lambda P_{st}\lambda x_e : P(w) = 1.\,\textsc{Bel}_x^w(P)$

According to (7a), the *believe*-sentence in (6) merely asserts something about John's doxastic state, something, furthermore, which we also know to be true. Consequently, the entry in (7a) alone is not sufficient to address the oddness of the *believe*-sentence in (6). But now suppose *believe* and *know* are competitors. It follows that an utterance of the *believe*-sentence in (6) prompts MP to compare it to the *know*-sentence as its alternative. As the *know*-sentence presupposes that Paris is in France while the *believe*-sentence is presupposition-less, and as this presupposition is known to be true, MP predicts that the *know*-sentence in (6) should block the *believe*-sentence, thereby deriving the latter's infelicity in any context in which it is common ground that Paris is in France. Assuming that contexts are sets of possible worlds that are compatible with background assumptions, MP predicts that any sentence of the form [*x believes that* ϕ] is felicitous in context C only if the presupposition of the *know*-alternative, i.e., [*x know that* ϕ], is not satisfied in C; i.e., only if there is at least one world in C in which ϕ is false.

MP as sketched so far is not entirely satisfactory. Although it yields appropriate results as far as felicity conditions go, it leaves something to be desired on the inferential side. To see this, consider the sentence in (8a). An utterance of this sentence is very likely to invite the inference that (the speaker believes that) Ann is not, in fact, 30 years old. Furthermore, in (8b), in which the first person pronoun replaces *Ann*, the parallel negative inference (that the speaker is not 30 years old) is much stronger.

(8) a. John believes that Ann is 30 years old.
$\rightsquigarrow$ Ann is not 30 years old (weak inference)
b. John believes that I am 30 years old.
$\rightsquigarrow$ I am not 30 years old (strong inference)

Neither of the two data points in (8) are accounted for by MP as it currently stands. This is because MP predicts, at best, that the sentences in (8) can be used only in contexts in which either the question of Ann's or the speaker's age is not common ground. But the attested inference is stronger, namely, that it is common ground that *not p*. To strengthen this inference is to perform what Chemla (2008) calls the *epistemic step*. It essentially consists of the assumption that the speaker is opinionated with respect to the truth of the complement (i.e. she has authority over *p*). Making that assumption permits strengthening the MP-inference from *it is not common ground that p* to *it is common ground that not p*, thereby arriving at (3b). Note this account also makes sense of the contrast between the sentences in (8). It is a safe assumption that the

[8] It is standard to assume that MP only compares alternatives that are contextually equivalent, although this has been challenged (Spector and Sudo, 2017, Anvari, 2018). This issue is not directly relevant in this paper.

speaker has authority about how old he is. It is much less clear whether the speaker can safely be assumed to know how old Ann is.

Finally, as exactly the same mechanism can be plausibly applied to Spanish *creer* (*believe*) and *saber* (*know*), the question arises whether *creerse* behaves like regular *creer* or whether it instantiates a different empirical profile. This is what we turn to in the following subsections. We will argue that RBC-inferences are markedly different from the MP-type inferences associated with *believe/creer*. In a nutshell, we will argue that MP-type inferences are cancelable while RBC-inferences are not (subsection 2.2); that MP-type inferences are epistemically weak while RBC-inferences are not (subsection 2.3), and that the MP-inferences project *existentially* from the scope of universal quantifiers while RBC-inferences project *universally* in the same environments (subsection 2.4).

2.2. Cancelability

The Chemla-strengthening of MP inferences is a defeasible process. In particular, it can be canceled by a continuation like …*and he/she is right!*, as witnessed by the felicity of (9) in both English and Spanish. Note that in (9) it is the Chemla-strengthened inference (*it is common ground that Ann is not 30 years old*) that is canceled, not the weaker MP-inference that underlies it (*it is not common ground that Ann is 30 years old*). The latter inference is triggered in the context against which the first sentence in (9) is evaluated while Chemla-strengthening affects the context *as updated by* the first sentence.

(9) *Juan cree que Ann tiene 30 años … ¡y tiene razón!*
'Juan believes that Ann is 30 years old … and he is right!'

The first difference between RBCs and regular belief reports is that the inference triggered by the former can*not* be canceled in subsequent discourse.[9,10]

(10) # *Juan* ***se*** *cree que Ana tiene 30 años … ¡y tiene razón!*
'Juan REFL believes that Ana is 30 years old … and he is right!'

Before we move on, recall that Chemla-strengthening becomes particularly robust when the MP inference pertains to the speaker. Thus, one way to appreciate the force of the RBC-inference is to note that even the most robust cases of Chemla-strengthening are in general cancelable, in contrast to RBC.

(11) *Juan cree que tengo 30 años … ¡y tiene razón!*
'Juan believes that I am 30 years old … and he is right!'

[9] As pointed out by Glass (2019) (her example 9, repeated below), the negative inference triggered by *yǐwéi* is cancelable.

(i) rénmén yǐwéi tō shì yìwànfùwēng … ér tā díquè shì
person-PL yǐwéi 3sg be billionaire … and 3sg indeed be
'People are under the impression that (=*yǐwéi*) she's a billionaire … and she actually is.'

[10] As Hsiao (2017) observes (her example 39, repeated below), the same pattern emerges with *liah-tsun*. Note the attitude-holder is first personal. We will return to this in subsection 2.3.

(i) # gua2 liah8-tsun2 i1 si7 huan1-a2 … ki5-sit8 i1 to7 si7
I think he COP aborigine … actually he exactly COP
'I thought that he was an aborigine … actually he is'

2.3. Epistemic Strength

Consider the example in (12). The sentence, in both Spanish and English, is felicitous only in contexts in which the question of whether it is raining is not settled. This is how things should be as predicted by MP. Furthermore, due to the fact that the attitude-holder in this example is the speaker, Chemla-strengthening is automatically canceled as it would generate the inference that (the speaker believes that) it is common ground that it is not raining which immediately contradicts the asserted content of the sentence that the speaker believes that it is raining.[11]

(12) *Creo que está lloviendo.*
'I believe that it is raining'.

The second difference between RBCs and regular belief reports is that RBCs are incompatible with first personal attitude-holders.[12, 13]

(13) # *Me creo que está lloviendo.*
'I REFL believe that it is raining'.

(13) is barely interpretable, in a way that is somewhat reminiscent of Moore's paradox in (14a) and, tellingly in light of the upcoming discussion, the unmarked reading of (14b).

(14) a. # It is raining but I don't believe it.
b. # I don't know that it is raining.

It appears that the inference triggered by RBCs, similar to assertive and presupposed content of sentences in general, is strongly tied to the speaker's personal beliefs, in contrast to MP inferences which pertain to speaker's belief about the common ground. As pointed out in footnote 11, beliefs about the common ground are in general stronger than personal beliefs: if x believes P is common ground then *ipso facto* x believes P, but not *vice versa*. Therefore, when negation is taken into account the situation reverses: if x does *not* believes that P is true (in particular, if x believes that P is false) then x does *not* believe that P is common ground. This

[11] Given standard assumptions, if x believes that it is common ground that P then x believes that P.

[12] In some cases first personal RBCs are fairly acceptable but with a rather different meaning.

(i) *Soy tan ingenuo que me creo todo lo que dicen en las noticias.*
'I'm so naïve that I REFL believe all that they say in the news.'

We suspect that RBCs have a second reading, on top of the one mentioned in the text, which effectively attributes to the attitude-holder a certain degree of gullibility or naïveté. This reading of *creerse* is, intuitively, rather similar to the English verb *buy* in an example like *He said he was a billionaire and she bought it*. This reading is difficult to access and becomes detectable only in certain environments such as the antecedent of conditionals (see also subsection 5.1). We have to leave this issue to future research.

[13] As pointed out by Glass (2019) (her examples 10 and 11, repeated below), *yǐwéi* is in fact compatible with first personal attitude-holders although in such cases it either signals that "the speaker [. . .] welcomes the hearer to disagree", (ib), or forces a past-temporal understanding of the reported belief, (ia). Neither of these two readings/implications are available for *creerse*. As the example used already in footnote 10 demonstrates, *liah-tsun* seems to pattern similarly to *yǐwéi* in this regard (see also the discussion in Hsiao2017).

(i) a. wǒ yǐwéi jīntiān yǒu ge jiǎngzuò
I *yǐwéi* today have DL talk
'I thought there was a talk today.'
b. wǒ gèrén yǐwéi nǐ yīnggāi zhèyàng zuò
I personally *yǐwéi* you should this-way do
'Personally, I think you should do this.'

is the sense in which, we believe, the negative inference triggered by RBCs is stronger than the MP inference associated with regular belief reports.

Finally, another piece of evidence (modelled after Glass, 2019) that points in the same direction is the contrast in (15).[14]

(15) a. *No sé si está lloviendo o no, pero Juan cree que está lloviendo.*
'I don't know if it's raining or not, but Juan believes that it is raining'.
b. # *No sé si está lloviendo o no, pero Juan* ***se*** *cree que está lloviendo.*
'I don't know if it's raining or not, but Juan REFL believes that it is raining.'

Again, the RBC-inference that it is not raining clashes with the first sentence, which states the speaker's ignorance.

2.4. Projection

MP-inferences are known to project existentially from the scope of universal quantifiers (Sauerland, 2008, a.o.). More specifically, and putting aside epistemic issues for simplicity, a plain belief report embedded under a universal quantifier such as *every student* is felicitous as long as there is at least one student who has a false belief. This is demonstrated by the felicity of the sentences in (16) in the target context.

(16) [*Context:* some students passed and the rest failed.]
Cada estudiante cree que ha aprobado.
'Every student believes that she passed'.

The third difference between RBCs and regular belief reports is that the former show a different behavior in the same environment, as witnessed by the infelicity of (17a). The sentence becomes fully acceptable if the context is manipulated in an appropriate manner, as in (17b).

(17) a. [*Context:* some students passed and the rest failed.]
Cada estudiante ***se*** *cree que ha aprobado.*
'Every student REFL believes that she passed.'
b. [*Context 1:* every student failed, or *Context 2:* it is not known whether there are any students who passed.]
Cada estudiante ***se*** *cree que ha aprobado.*
'Every student REFL believes that she passed.'

Judgments become sharper with an example like (18). Given the context in (18), the sentence involving RBCs is clearly degraded, while the alternative with *creer* is fine.

(18) [*Context:* in the aftermath of a swimming match, the only possible outcome of which is that exactly one of the competitors wins.]
a. *Cada una de las nadadoras cree que ha ganado la carrera.*
'Every swimmer believes that she has won the race'.

[14] Again, things are different with *yǐwéi*, as the felicity of Glass's example 7 reported below demonstrates.
(i) wǒ bù zhīdào yǒu-méi-yǒu défēn, dànshì zhège qiúyuán yǐwéi défēn le
I not know have-not-have score, but this-CL ball-player *yǐwéi* score ASP
'I don't know whether the player scored or not, but he's under the impression that (= *yǐwéi*) he did.'

b. # *Cada una de las nadadoras* ***se*** *cree que ha ganado la carrera.*
'Every swimmer REFL believes that she has won the race'.

The infelicity of (17a) and (18b) (in their respective contexts) strongly suggests that the negative inference triggered by RBCs projects universally from the scope of universal quantifiers. Thus, the oddness of (18b) can be easily explained if the projected inference has the universal force that every swimmer lost the race. The felicity of (16) and (18a) (in their respective contexts), on the other hand, is compatible with the standard assumption that MP inferences project existentially from the scope of universal quantifiers (approximately, at least one student failed for (16), and at least one swimmer lost for (18a)).

2.5. Interim summary

Although RBCs and regular belief reports both tend to imply that their complement clause is false, there are at least three ways in which the falsity inference of RBCs is special: it is non-cancelable, epistemically strong and it projects universally from the scope of universal quantifiers. We take these three properties to be sufficient evidence for the claim that the mechanism underlying the negative inference of RBCs is distinct from the one associated with regular belief reports. *Maximize Presupposition!* may be the appropriate mechanism as far as regular belief reports go, but it is certainly inappropriate for RBCs.[15]

In the following two sections we turn to the question of just what the mechanism behind RBCs is. We will consider two hypotheses. In section 3 we explore the hypothesis that RBCs are "contrafactive", in that they presuppose the falsity of the clausal complement. In section 4 we discuss an alternative idea according to which RBCs trigger the presupposition that the attitude holder is *wrongly* opinionated with respect to the context of the clausal complement.

3. The Contrafactivity Hypothesis

3.1. The basic idea

The contrafactivity analysis boils down to the claim that *creerse* is contrafactive. Much like how *saber* (to know) is factive, in that it presupposes the truth of its complement, *creerse* is now claimed to be contrafactive, in that it is taken to presuppose the *falsity* of its clausal complement.

(19) $[\![\text{creer}]\!]^w = \lambda P \lambda x.\, \text{B}\textsc{el}_x^w(P)$

(20) $[\![\text{saber}]\!]^w = \lambda P \lambda x : P(w) = 1.\, \text{B}\textsc{el}_x^w(P)$

(21) $[\![\text{creerse}]\!]^w = \lambda P \lambda x : P(w) = 0.\, \text{B}\textsc{el}_x^w(P)$

[15]There are implementations of *Maximize Presupposition!* that come closer to capturing RBC-inferences. Magri (2009) and Marty (2017) provide implementations of MP within the framework of (grammatical) exhaustification which generate inferences that are often stronger than those predicted by standard MP. Two points merit consideration. First, the empirical behavior of RBCs and plain belief reports is so different that if exhaustification is appropriate for former then it is not appropriate for the latter. Second, an exhaustification approach to RBCs, pushed to extreme for maximum coverage, becomes essentially a notational-variant of the contrafactivity analysis discussed in the next section, and will suffer from the same problem (namely, it also would have to rely on syntactic neg-raising). It is at the moment unclear to us whether anything can be gained by switching from MP as a principle of language-use to an implementation within the exhaustification framework as far as the data in this paper are concerned, although the issue needs to be considered more carefully.

If true, the contrafactivity of RBCs is rather remarkable as, to our knowledge, no contrafactive predicate has so far been attested in the literature. Indeed, Holton (2017) goes as far as to claim that no such predicate exists in natural language.[16] The contrafactivity analysis characterizes the RBC-inference as a presupposition. The prediction, then, is that these inferences should behave like presuppositions do in general. Using *know* as baseline, in the rest of this subsection we demonstrate that this prediction is borne out.

In subsection 2.2 we pointed out that RBC-inferences, unlike MP-inferences, cannot be canceled in subsequent discourse. The same holds true of the factive presupposition of *know*.

(22) a. # Juan knows that Ana is 30 years old ... and he is wrong!
b. Juan believes that Ana is 30 years old ... and he is right!
c. # *Juan se cree que Ana tiene 30 años ... ¡y tiene razón!*
'Juan REFL believes that Ana is 30 years old ... and he is right!'

In subsection 2.3 we argued that the epistemic strength of RBC-inferences is stronger than that of MP-inferences. Again, the same is true for the factive presupposition of *know*. Looking at (23a) in particular, the speaker cannot use a sentence that carries the presupposition *P* if he or she is ignorant about whether *P* is true. This observation applies to *know* (with the presupposition that it is raining) exactly like it applies to *creerse* (with the presupposition that it is not raining) under the contrafactivity analysis.

(23) a. # I don't know that it is raining.
b. I believe that it is raining.
c. # *Me creo que está lloviendo.*
'I REFL believe that it is raining.'

(24) a. # I don't know whether it is raining or not, but John knows that it is raining.
b. I don't know whether it is raining or not, but John believes that it is raining.
c. # *No sé si está lloviendo o no, pero Juan se cree que está lloviendo.*
'I don't know if it's raining or not, but Juan REFL believes that it is raining.'

In subsection 2.4 we pointed out that RBC-inferences project universally from the scope of universal quantifiers. This behavior is, of course, the hall-mark of presuppositions.

(25) *Every student knows that he passed the exam.*
$\rightsquigarrow$ every student passed the exam

(26) *Cada estudiante se cree que ha aprobado.*
'Every student REFL believes that she passed.'
$\rightsquigarrow$ every student <u>failed</u> the exam

Not only can the contrafactivity analysis account for the data so far discussed, it also makes further predictions that happen to be true. Specifically, presuppositions are known to project in polar questions and from the scope of existential modals. The same holds for RBC inferences as well.

[16]Holton does in fact mention RBC in a footnote (Holton, 2017: p.250, n.3), but he does not elaborate further, reporting that his consultants were unsure about the exact content of the inference. *Liah-tsun* as analysed by Hsiao (2017) is certainly a candidate as well. But note that, the hall-mark of presuppositions being their projection profile, the relevant facts for *liah-tsun* are not yet known.

(27) a. Does John know that it is raining?
⇝ it is raining
b. *¿Se cree Juan que está lloviendo?*
'Does Juan REFL believe that it is raining?'
⇝ it is not raining

(28) a. John might know that it is raining.
⇝ it is raining
b. *Puede que Juan se crea que está lloviendo.*
'might that Juan REFL believe that it is raining.'
⇝ it is not raining

We take these observations to lend strong *prima facie* support to the contrafactive analysis.

3.2. The Polarity Reversal Problem

Before uncorking the champagne and toasting to contrafactivity however, the analysis faces a simple and possibly devastating difficulty. As pointed out briefly in section 1, the polarity of RBC inferences reverses under negation.[17]

(29) a. *Juan se cree que está lloviendo.*
'Juan REFL believes that it's raining.'
⇝ it is not raining
b. *Juan* ***no*** *se cree que está lloviendo.*
'Juan doesn't REFL believe that it's raining.'
⇝ it is raining

The problem that (29b) raises for the contrafactivity analysis is plain: just like polar questions and existential modals, negation is a presupposition hole: any presupposition triggered in the scope of negation should either project or be locally accommodated. Neither of these two possibilities seem to account for (29b).

(30) The contrafactivity analysis predicts (29b) to mean either ...
a. *it is not raining and it is not the case that Juan believes that it is raining* (if the contrafactive presupposition projects) or ...
b. *if it is not raining, then Juan believes that it is raining* (if the contrafactive presupposition is locally accommodated)

Similar results are obtained when we embed RBCs under a negative universal quantifier.

(31) *Ningún estudiante se cree que ha suspendido.*
No student REFL believes that she has failed.
⇝ every student has failed.

[17]As pointed out by Hsiao (2017) (her example 34, repeated below), *liah-tsun* cannot be negated. This is, perhaps, the most crucial difference between *liah-tsun* and *creerse*.

(i) # il bo5 liah8-tsun2 a1-ing1 tsa1-hng1 kah4 ong5-sian1-sinn1 tso3-hue2.
he neg think A-ing yesterday with Wang-Mr. be.together
'He didn't mistakenly think that A-ing was with Mr. Wang yesterday.'

Let us call this the Polarity Reversal (hf. PR) Problem. How serious is the PR problem? Recall that the contrafactive account made several good predictions. It seems a worthwhile enterprise to try to rescue it somehow. To do that, we will explore an intuitive subsidiary hypothesis: given that non-reflexive *creer* is a neg-raising predicate, perhaps *creerse* is also neg-raising and the PR problem is only a problem as long as neg-raising is ignored.

It is well-known that doxastic predicates like *believe* and *creer* are neg-raising predicates, in the sense that under negation they give rise to interpretations that are stronger than predicted (Horn, 1978). Thus the inferences from (32a) to (32b) seems intuitively valid although the latter, given otherwise standard assumptions about negation and the meaning of *believe*, should also be compatible with John being totally ignorant about whether it is raining or not.

(32) a. *John doesn't believe that it's raining.*
b. *John believe that it's not raining.*

On the syntactic account of neg-raising (Collins and Postal, 2014) in (32a) the negation is actually interpreted at LF in the embedded clause but raises to the matrix clause where it is pronounced. In a nutshell, two copies of negation are present, the higher is pronounced and the lower is interpreted.

(33) LF of (32a): John ~~NEG~~ believe that [it is NEG raining]

Now, what if this mechanism is also available for *creerse*?

(34) Juan no (se) cree que está lloviendo
LF: Juan ~~NEG~~ (se) cree que [NEG [está lloviendo]]

This assumption coupled with the claim that *creerse* is contrafactive, now predicts the polarity reversal behavior noted above.

(35) *Juan no se cree que está lloviendo.*
Assertion: Juan believes that it is not raining
Presupposition: It is not the case that it is not raining

Thus the syntactic account of neg-raising can solve the contrafactivity analysis' PR problem. There are, however, several arguments against the syntactic account of neg-raising (see Romoli, 2013 in particular and Collins, 2019 for a recent argument, and references therein) and it seems prudent to ask whether the PR problem really forces the contrafactivity analysis to commit to the syntactic account.

On the other hand, there are several *semantic* analyses of neg-raising available (the homogeneity-based account of Križ, 2015, the scalar implicature-based account of Romoli, 2013, the presuppositional account of Gajewski, 2007). As far as we can see, none of the semantic accounts can solve the PR problem. The reason, in a nutshell, is that in order to solve the PR problem via neg-raising a connection must be established between the doxastic state of the attitude-holder and the truth/falsity of the complement clause. The syntactic account accomplishes this by interpreting the negation in the scope of the attitude predicate, thereby enriching the attitude-holder's reported doxastic state while at the same time reversing the polarity of the contrafactive presupposition. The semantic accounts, on the other hand, fail to establish this connection. We illustrate this with Gajewski's presuppositional account.

Abstracting from orthogonal concerns, Gajewski's proposal boils down to the claim that *believe* (and *creer*) triggers the presupposition that the attitude-holder is opinionated with respect to the complement clause.

(36) $[\![\text{creer/believe}]\!]^w = \lambda P \lambda x : \text{BEL}_x^w(P) \vee \text{BEL}_x^w(\neg P).\, \text{BEL}_x^w(P)$

Nothing changes in the unembedded case. But under negation, the excluded middle presupposition projects thereby strengthening the truth-conditions of the sentence.

(37) *John doesn't believe that it is raining.*
PRESUPPOSITION: $\text{BEL}_j^w(r) \vee \text{BEL}_j^w(\neg r)$
ASSERTION: $\neg\text{BEL}_j^w(r)$
$\Rightarrow$ true iff $(\text{BEL}_j^w(r) \vee \text{BEL}_j^w(\neg r)) \wedge \neg\text{BEL}_j^w(r)$ iff $\text{BEL}_j^w(\neg r)$

Now suppose we superimpose the excluded middle presupposition on the contrafactive presupposition.

(38) $[\![\text{creerse}]\!]^w = \lambda P \lambda x : P(w) = 0 \wedge (\text{BEL}_x^w(P) \vee \text{BEL}_x^w(\neg P)).\, \text{BEL}_x^w(P)$

The prediction is clearly inadequate. As made explicit below, we effectively predict (39) to be true iff Juan knows that it is not raining.

(39) *Juan no se cree que está lloviendo.*
LF: Juan NEG se-believe [it is raining]
PRESUPPOSITION:
1. $\text{BEL}_j^w(r) \vee \text{BEL}_j^w(\neg r)$
2. $r(w) = 0$
ASSERTION: $\neg\text{BEL}_j^w(r)$
$\Rightarrow$ true iff $r(w) = 0 \wedge (\text{BEL}_j^w(r) \vee \text{BEL}_j^w(\neg r)) \wedge \neg\text{BEL}_j^w(r)$ iff $r(w) = 0 \wedge \text{BEL}_j^w(\neg r)$

It seems, then, that the contrafactivity hypothesis only works if it is supplemented with the syntactic account of neg-raising. In the next section we explore an alternative analysis which does remove the reliance on the syntactic account, but is empirically less successful than the contrafactivity analysis.

4. The Enriched Excluded Middle Hypothesis

4.1. The basic idea

According to Gajewski's account, regular belief reports trigger the (soft) presupposition that the attitude-holder is opinionated with respect to the embedded proposition. We would like to suggest that the special ingredient of *creerse* is a richer excluded middle presupposition. Specifically, the idea is that *creerse* triggers the presupposition that the attitude-holder is *wrongly* opinionated with respect to the embedded proposition: if the proposition is true the attitude-holder believes it to be false and if the proposition is false then the attitude-holder believes it to be true.

(40) a. $[\![\text{creer/believe}]\!]^w = \lambda P \lambda x : \text{BEL}_x^w(P) \vee \text{BEL}_x^w(\neg P).\, \text{BEL}_x^w(P)$
b. $[\![\text{creerse}]\!]^w = \lambda P \lambda x : (P(w) = 0 \wedge \text{BEL}_x^w(P)) \vee (P(w) = 1 \wedge \text{BEL}_x^w(\neg P)).\text{BEL}_x^w(P)$

(40b) predicts that RBCs, when unembedded, are true iff the complement clause is false and the attitude-holder believes that it is true. Furthermore, under negation the enriched excluded middle presupposition will project. We then predict the sentence to be true iff the complement clause is true and the attitude-holder believes that it is false. Thus the enriched excluded middle analysis seems to make correct the prediction for the basic cases and the cases involving embedding under negation. The reader can verify that an analysis along the lines of (40b) will also derive the projection facts, discussed in subsection 2.4, and the fact that RBC inferences are epistemically strong, as discussed in 2.3.

We would, however, like to point out two shortcomings of this analysis, one possibly minor and one major. We discuss the latter in the next subsection. The minor difficulty is that neg-raising inferences are known to be defeasible. In Gajewski's framework this means that the original excluded middle inference is a *soft* presupposition. If the enriched excluded middle that we have postulated for *creerse* is in the same category then we cannot explain why RBC inferences cannot be canceled in subsequent discourse, as discussed in 2.2. Some justification, then, is needed to explain why the enriched excluded middle inference is a *strong* presupposition even though the excluded middle itself is a soft presupposition.

4.2. The problem with Polar Questions

The major difficulty pertains to projection. As pointed out in at the end of section 3.1, RBC inferences project from polar questions.

(41) *¿Se cree Juan que está lloviendo?*
'Does Juan REFL believe that it is raining?'
$\rightsquigarrow$ it is not raining

This fact cannot be explained by (40b). At best, we predict the project inference to be that the attitude-holder is wrongly opinionated with respect to the embedded proposition. In fact, it remains a mystery why this inference itself surfaces in the enriched form that we have observed.

4.3. Interim summary

The theoretical situation is perplexing. We have an analysis which is empirically rather successful, namely the contrafactivity analysis, but necessitates commitment to the syntactic account of neg-raising, which we think is not desirable. On the other hand, we have sketched an alternative analysis which does not rely on the syntactic account but at the cost of empirical coverage. We leave the ultimate resolution of this dilemma to future work.

5. Some Further Empirical Observations

5.1. Question embedding and other complements

The data discussed above involve cases where *creerse* embeds propositions. Crucially, *creerse* can also take complements that plain *creer* does not admit; namely, interrogatives and small clauses. We briefly discuss these in turn.

Let us start by considering what is maybe the most surprising of these observations: when they are negated, RBCs can embed *wh*-interrogatives.

(42) *Juan no se cree {quién vino, dónde es el concierto, qué hay que hacer para entrar}.*
Juan not REFL believe {who came, where is the concert, what one has to do to get in}.

As illustrated in (43a), the ability to embed interrogatives is only available under negation. Furthermore, as illustrated in (43b) and (43c), even when *creerse* is embedded under negation it can only embed *wh*-questions to the exclusion of polar and alternative questions.

(43) a. **Juan se cree {quién vino, dónde es el concierto, qué hay que hacer para entrar}.*
b. **Juan no se cree si está lloviendo.*
Juan doesn't REFL believe whether it's raining.
c. **Juan no se cree si el auto es rojo o azul.*
Juan doesn't se believe whether the car is red or blue

Now, what does, e.g., the *who* case of (42) actually *mean*? Intuitively, the sentence is true iff there is at least one person x who in fact came but Juan believes that x did not come. Thus, consider a context where Mary and Ann came, and Bill did not. Sentence (42) would then be true as long as John either believes that Mary did not come or he believes that Ann did not come. Importantly however, having a false belief regarding a *negative* answer to the question does not license the construction. Thus if Juan believes that Mary, Ann *and Bill* came the sentence is not acceptable.[18]

We should additionally note that the use of an embedded interrogative requires the answer to the embedded question to have been recently introduced into the common ground. Intuitively, (42) can only be used when someone has told Juan who came, but he does not believe it and has different beliefs about it.[19] It's not surprising then that *dative* belief constructions in Spanish, obtained by adjoining the dative pronoun to the predicate *creer*, pattern with RBCs in this respect:

(44) *Juan no me cree quién vino.*
'Juan doesn't 1sg:DAT believe who came.'

(44) seems to have analogous truth conditions to (42), modulo the fact that the former sentence implies that it's the speaker who has provided an answer to the question.

Besides interrogatives, *creerse* can also embed small clauses, where the reflexive pronoun the subject of the small clause, as in (45). This alternative is also attested for reflexive belief constructions in other Romance languages, such as French and Italian.

(45) *María se cree muy mala.*
'María REFL believes herself to be very bad.'
$\rightsquigarrow$ María falsely believes that she is very bad.

While superficially similar, the inference triggered by (45) is weaker than the ones analyzed so far: it can be canceled —it allows the continuation *and she is right!*—, and does not arise under negation.

[18]The facts pertaining to the ability of *creerse* to embed *wh*-questions exclusively only when it is embedded under negation are potentially significant in the context of recent attempts in deriving the selectional restrictions of various predicates from semantics assumptions (Mayr, 2017 and Theiler et al., 2018, a.o.). For space limitations we have to leave this to future work.

[19]This suggests that perhaps in such constructions the second meaning of *creerse* (see footnote 12) is the culprit.

Given that, in these cases, the reflexive is presumably generated in the embedded clause (as subject) and only raises to the matrix clause to receive case (i.e. raising to object, Chomsky, 1993), we consider these constructions plain belief reports, and the corresponding inference is just an MP-type inference.

5.2. Dative belief construction

As observed above, the predicate *creer* can also take a dative pronoun as complement. Could RBC be thought of as a special case of this *Dative* Belief Construction (henceforth, DBC), also existent in English?[20]

(46) a. Juan believed you that it was raining.
b. *Juan **te** creyó que estaba lloviendo.*
'Juan 2sg:DAT believed that it was raining'.

The DBC in (46) is typically taken to mean *believed you when you tell him* (Chemla, 2008). The RBC in Spanish could then be analyzed by saying that the "inducer" and receiver of the belief are the same person. Sentence (1), repeated below, would then be interpreted as *Juan believes himself when he tells himself that it's raining*.

(1) *Juan se cree que está lloviendo.*
'Juan REFL believes that it is raining.'

Treating the RBC as a special case of DBC would give us the possibility of expanding our predictions to other uses of the predicate *believe* in Spanish and potentially other languages. However, Spanish RBCs and DBCs display important differences. To begin with, unlike our original RBC example in (1), repeated above, unembedded DBCs in Spanish are quite deviant in present tense:

(47) ?? *Juan **te** cree que está lloviendo.*
'Juan 2sg:DAT believes that it is raining'

Present tense DBCs are however fully acceptable when embedded under negation and in polar questions.

(48) a. *Juan no **te** cree que está lloviendo.*
'Juan doesn't 2sg:DAT believe that it is raining'
b. *¿**Te** cree Juan que está lloviendo?.*
'Does Juan 2sg:DAT believe that it is raining?'

Negative sentences such as (48a) trigger the inference that it is, in fact, raining. Crucially, this inference does not arise from the polar question in (48b), indicating that it is not as strong as the RBC-inference.

Dative and reflexive constructions also differ in their ability of taking non-human subjects. This can be taken to be a direct consequence of the fact that DBCs have a speech-act ingredient (believing *p* as a result of *being told p*):

[20] The claims made here about the inferential pattern of Spanish DBC should not be extended to English. English examples are only used for clarity purposes.

(49) *El perro no se/#te cree que está lloviendo.*
'The dog does not REFL/2sg:DAT believe that it is raining.'

Last but not least, the reflexive pronoun in Spanish is known to have other non-argumental uses (cf. footnote 2). In particular, the reflexive can be attached to other attitudinal predicates, which cannot take dative arguments. This is the case of the predicate *pensar* (*think*):[21]

(50) *Juan se piensa que está lloviendo.*
'Juan REFL thinks that it is raining.'
⇝ it's not, in fact, raining

Crucially, (50) gives rise to an inferential pattern analogous to our RBC, at least in the positive form. Indeed, *creerse* and *pensarse* have been treated as alternatives to each other (Di Tullio, 2018). The construction with *pensar* was left outside the scope of this paper because it presents some minor differences with RBC, specifically under negation. However, its existence suggests that providing a semantic account of the "reflexivization" process is an urgent *desideratum*. We hope to address this issue in future work.

5.3. Cross-linguistic overview: The case of French *s'imaginer*

We have tackled the semantics for *creerse* as a unit. The presence of a contrafactive presupposition, however, seems to be tightly linked to the "reflexivization" process that allows deriving *creerse* from *creer* —and possibly *pensarse* from *pensar*. Indeed, it was brought to our attention that French also displays a RBC, built by adjoining the reflexive pronoun to the predicate *imaginer* (*imagine*; p.c. Paul Egré). As illustrated in (51), French *s'imaginer* gives rise to similar inferences to Spanish *creerse*.

(51) a. *Jean s'imagine qu'il est en train de pleuvoir.*
'Jean REFL thinks it's raining.'
⇝ it is not raining.
b. *Jean ne s'imagine pas qu'il est en train de pleuvoir.*
'Jean doesn't REFL think it's raining. '
⇝ it is raining.
c. #*Je m'imagine qu'il pleut.*
'I REFL think it's raining.'
d. #*Jean s'imagine que j'ai une soeur et il a raison!*
'Jean REFL thinks I have a sister, and he's right!'

These examples provide further evidence suggesting that the contrafactive inference arises, at least partially, as a result of adjoining the reflexive pronoun: in Spanish and French, *different* predicates give rise to similar inferences in their reflexive variant.

However, "reflexivizing" an attitudinal predicate is not enough to make it contrafactive: as ob-

[21] We should note that Spanish also has a reflexive variant of the factive predicate *saber* (*to know*). Reflexive saber can only take nominal complements not propositional ones:
(i) *Juan se sabe la lección*
Juan REFL knows the lesson.
The reflexive in these cases functions as a telicity marker: the sentence above implies that he knows the lesson *completely*.

served, many predicates that have reflexive variants do not give rise to a contrafactive inference. Besides the already mentioned *saberse* —which cannot take propositional complements—, it's worth mentioning that Spanish *imaginar* (*imagine*) also has a reflexive alternative *imaginarse*. Unlike *s'imaginer* in French, Spanish *imaginarse* is equivalent to plain *imaginar* —it triggers MP-type inferences.

(52) a. *Me imagino que está lloviendo.*
'I REFL think it's raining.'
b. *Juan se imagina que tengo una hermana, ¡y tiene razón!*
'Juan REFL thinks I have a sister, and he's right! '

A compositional account of contrafactivity would then require modelling the semantic import of the reflexive pronoun as a function of the predicate to which is attached: it is adjoining the reflexive pronoun to only *certain* predicates which results in the addition of a contrafactive presupposition. We believe the data presented here is too sparse to draw a sound generalization about the semantic import of the reflexive.

6. Conclusions

This article contributes to the research on belief reports by bringing what appears to be a 'contrafactive' predicate into the picture. We have investigated the puzzling inferential behavior of Reflexive Belief Constructions in Spanish. We have shown that RBC-inferences cannot be accounted for by standard treatments of belief reports, in terms of MP-inferences. Instead, we explored two hypotheses: that *creerse* is contrafactive and that *creerse* carries an *enriched* excluded middle presupposition. The latter has wider empirical coverage but succeeds only if it is supplemented with the syntactic account of neg-raising. The latter does not rely on syntactic neg-raising, but has narrower empirical coverage. Future research needs to address this dilemma.

For the sake of simplicity, and as a *necessary* first step, we have provided here a non-compositional account of RBC: we gave a meaning to the predicate *creerse* as a whole, without assessing the semantic import of the reflexive pronoun. As observed in section 5, a more sophisticated, compositional account of RBCs needs to be made to account for both cross-linguistic and within-language data.

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Revisiting the elasticity of verb meaning and the *way*-construction in English[1]

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Abstract. Rappaport Hovav and Levin (2010) argue that result verbs (e.g. *break*) are more restricted than manner verbs (e.g. *wipe*) with regard to argument realization, since result verbs do not permit object deletion (e.g. **John broke*) or nonselected objects (e.g. **John broke his fingers bloody*). In the present paper, I argue that result verbs can permit nonselected objects, i.e. I show that they are found in the *way*-construction when the result state they encode is predicated of a patient that despite not being overtly realized is semantically implicit. In a similar vein, Marantz (1992), Levin (1993) and Levin and Rappaport Hovav (1995) argue that unaccusative verbs are never found in the *way*-construction, as only unergative verbs are permitted. However, as Kuno and Takami (2004) note, there are some unaccusative verbs (e.g. *roll*) that can appear in this construction. In this respect, I argue that unaccusative verbs permit the *way*-construction when they do not encode result states. Consequently, I contend that unaccusativity is not the constraint imposed by the *way*-construction on the verb classes permitted, contra previously assumed. In short, I argue that both result and unaccusative verbs appear to be more elastic with regard to argument realization than previously claimed.

Keywords: argument realization, manner, result, unaccusativity, nonselected objects.

1. Introduction

Rappaport Hovav and Levin (2010) (also Levin and Rappaport Hovav, 1991, 1995, 2013, 2014; Rappaport Hovav and Levin, 1998; Rappaport Hovav, 2008, 2014, 2017; Levin, 1999, 2015, 2017) (hereafter, RHL) argue that verbs fall within two wide semantic classes: manner verbs (1a), which encode a manner of action, but not any result state from that action, and result verbs (1b), which encode a result state but not the manner of action that brought about the result state.

(1) a. Manner verbs: *run*, *swim*, *blink*, *sweep*, *poison*, *wipe*, *scrub*, etc.
  b. Result verbs: *break*, *kill*, *clean*, *destroy*, *arrive*, *go*, *shatter*, etc.

RHL strongly contend that no single verb can encode both a manner of action and a result state, what they call Manner/Result Complementarity.[2] RHL argue that such complementarity is a consequence of how roots are inserted into the event structure, since a single root can only be inserted as a modifier of the so-called ACT predicate, or as an agument of the so-called BECOME predicate (see Rappaport Hovav and Levin, 1998). Manner/Result Complementarity thus comes about since a single root cannot be inserted as both a modifier and as an argument at the same time. In addition, RHL further argue that roots are inserted into the event structure as modifiers or arguments depending upon their root ontology, taking manner and result as

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[2]More specifically, RHL (p. 26) argue that Manner/Result Complementarity does not apply to verbs *per se*, but to roots. As Rappaport Hovav (2017) notes, the motivation for this claim comes from the structure of verbs in other languages (e.g. Lakhota) in which a single verb can encode both a manner of action and a result state but such verbs are clearly bimorphemic in that prefixes and stems combine to form complex verbs.

root ontologies.[3] Thus, Manner/Result Complementarity also holds as a restriction on the entailments roots can have, since a single root either encodes manner or result, but never both.[4]

RHL make the interesting claim that the distinction between manner and result is grammatically relevant, since manner and result verbs further differ in argument realization. The facts bear this out, since, as shown below, canonical manner verbs such as *sweep* or *run* permit object deletion and nonselected objects, whereas canonical result verbs like *dim* or *break* do not.

(2) a. All last night, John swept.
b. The joggers ran the pavement thin. (Levin and Rappaport Hovav, 1995: 53)

(3) a. *All last night, John broke.
b. *We dimmed the room empty. (Rappaport Hovav, 2008: 23)

In a similar vein, Marantz (1992), Levin (1993) and Levin and Rappaport Hovav (1995) argue that only unergative verbs are found in the *way*-construction in English (e.g. *John kicked his way in*), i.e. a nonselected object construction (Levin and Rappaport Hovav, 1995). Unaccusative verbs thus do not appear to permit nonselected objects either. This unaccusativity restriction appears to be correct since canonical unaccusative verbs are not permitted in this construction, as shown in (4).

(4) a. *The flower bloomed its way to a prize. (Levin, 1993: 99)
b. *They disappeared their way off the stage. (Levin, 1993: 99)
c. *The apples fell their way into the crates. (Levin and Rappaport Hovav, 1995: 148)

However, Kuno and Takami (2004: 74-5) show that some unaccusative verbs are found in this construction (5), thus suggesting that the constraint on the verb classes permitted may not be related to unaccusativity.

(5) a. The big rock rolled its way down the mountain.
b. A steel rope snaked its way across the construction site.
c. Rainwater trickles its way to the underground pool.

In the present paper, I argue that the argument realization options of result verbs need to be revisited. In this respect, I argue that result verbs can be compatible with nonselected objects as I show that they frequently appear in the *way*-construction. More specifically, I contend that result verbs are found in the *way*-construction when the result state they encode is predicated of an object that while not being overtly realized is semantically implicit. Further, I argue that the *way*-construction in English is not sensitive to unaccusativity, but rather to whether the verb encodes a result state predicated of the entity denoted by the subject. This is related to the fact that within the unaccusative verb class, most unaccusative verbs already encode a

[3]For root ontologies, i.e. ontological classifications that are relevant when determining grammatical properties, see Rappaport Hovav and Levin (1998), Reinhart (2002), Ramchand (2014), Alexiadou, Anagnastopolou, and Schäfer (2015), Rappaport Hovav (2017) *i.a.* In contrast, the view that roots have an ontological classification relevant when determining grammatical properties is rejected in Borer (2005), Acquaviva (2014), Acedo-Matellán and Mateu (2014), *i.a.*

[4]Manner/Result Complementarity, however, has been challenged and shown to not hold categorically (Goldberg, 2010; Husband, 2011; Mateu and Acedo-Matellán, 2012; Beavers and Koontz-Garboden, 2012, 2017; and see Levin and Rappaport Hovav, 2013, 2014; Rappaport Hovav 2017, for some responses). Insofar as the present paper is concerned with argument realization, and not whether Manner/Result Complementarity holds as a restriction on verb/root meaning, this will not be further explored in the present paper, but see the references aforementioned.

result state predicated of the entity denoted by the subject (e.g. *die*, *arrive*, *disappear*, *bloom*). Hence, integrating this type of unaccusative verbs in the *way*-construction would entail that the entity denoted by the subject has undergone two result states at once, the one denoted by the construction and the one encoded by the verb (e.g. **John died his way out of prison*), which has been argued to not be grammatically possible (Goldberg, 1991; Tenny, 1994; Tortora, 1998; Matsumoto, 2006). I argue that this grammatical constraint in the number of result states that can be predicated of the same entity explains the ungrammaticality of the examples in (4): unaccusativity is not what prevents unaccusative verbs of the *arrive* sort from appearing in the *way*-construction, but rather the fact that these unaccusative verbs encode a result state predicated of the entity denoted by the subject. I note that this is borne out by the fact that unaccusative verbs that do not encode a result state are indeed found in the *way*-construction. In order to illustrate this, I focus on the *roll* verb class in Levin (1993), i.e. *roll*, *slide*, *whirl* and *spin*, and I argue that these verbs are unaccusative and yet are found in the *way*-construction since they do not encode a result state.[5]

The present paper is structured as follows. In Section 2, I briefly summarize the proposal by RHL to equate manner and result with so-called nonscalar and scalar changes, as well as the diagnostics to tell manner and result verbs apart. In Section 3, I present a brief overview of the *way*-construction in English. I argue then that *roll* verbs are unaccusative and yet are found in this construction. In Sections 4 and 5, I revisit the argument realization options of result and unaccusative verbs and argue that both verb classes appear to be more elastic with regard to argument realization than previously claimed. Section 6 concludes the paper.

2. Manner and Result

RHL (p. 28) argue that the crucial difference between result and manner verbs is related to the types of changes these verbs denote, i.e. result verbs encode scalar changes, whereas manner verbs encode nonscalar changes. In this respect, result verbs, insofar as they encode scalar changes, lexically specify a scale (see Tenny, 1994; Ramchand, 1997; Hay, Kennedy and Levin, 1999; Kennedy and McNally, 2005; Beavers, 2011; Rappaport Hovav, 2008, 2014; Beavers and Koontz-Garboden, 2012, 2017, *i.a.*), where a scale is formed by a set of degrees, which specify measurement values, on a specific dimension, e.g. width, length, alive-dead etc., with an ordering relation (e.g. a warming and a cooling event differ in the increasing and decreasing of the temperature of the patient) (Kennedy and McNally, 2005). A scalar change then "[...] involves a change in value of [an] attribute in a particular direction along the scale, with the direction specified by the ordering relation." (RHL p. 28). For instance, the verb *die* is related to an attribute (i.e. *dead*) which holds of an argument when it undergoes a dying event. Thus, result verbs encode a change in some property of a patient (i.e. a result state). For instance, when a patient participates in an event of scalar change, at the end of it, there is a modification in the degree of some value/property of the patient (e.g. a soup becoming cooler/warmer after an event of cooling/warming).

In contrast, RHL propose to equate manner verbs with nonscalar changes, i.e. "any changes that cannot be characterized in terms of an ordered set of values of a single attribute." (RHL p. 32). Manner verbs thus encode nonscalar changes since they relate to complex combina-

[5]The examples in this paper are extracted from web searches (Web), Google Books (GBooks), and Corpus of Contemporary American English (COCA).

tions of various changes, but these complex combinations do not constitute an ordered relation and therefore no scalar change follows (e.g. *run*, *walk*, *exercise*). In short, as Beavers and Koontz-Garboden (2012: 343) note, "a manner is a complex sequence of separate changes that collectively define an action, but do not necessarily add up to a single cumulative change along any one dimension."

2.1. Telling manner and result apart

RHL lay out three diagnostics to capture whether a verb encodes a result state. The first diagnostic relates to denying that a change has occurred, and therefore, that a specific result state holds of a participant, i.e. if a participant engages in an event involving scalar change, at the end of the event, such participant must have an altered degree of some property or value, and therefore, denying that this change has occurred results in a contradiction if the verb encodes a result state, as illustrated in (6).[6]

(6) a. John just melted the cheese, #but it is not melted/#but nothing is different about it.
b. John just killed his dog, #but it is not dead/#but nothing is different about it.
c. John just broke the vase, #but it is not broken/#but nothing is different about it.

The infelicity of result verbs with this diagnostic contrasts with manner verbs, as applying the same diagnostic does not result in a contradiction, as no result state is encoded.

(7) a. John just wiped the counter, but nothing is different about it.
b. John just poisoned my dog, but nothing is different about it.
c. John just hit the vase, but nothing is different about it.

The second diagnostic relates to the fact that result verbs are argued to permit a narrow range of possible result phrases (cf. *John kicked the door open*), whereas manner verbs allow a wide range.

(8) a. John wiped the table shiny.
b. Tom mopped the floor spotless.
c. The child scrubbed his hands clean.

More specifically, result verbs only permit result phrases that further specify the result state encoded by the verb, i.e. if the verb encodes a result state along a specific dimension (e.g. temperature), the result phrase must denote a result state on the same dimension (9). Hence, result verbs do not permit result phrases that introduce a result state on a dimension different from the one encoded by the verb (10).

(9) a. John broke the vase in half.
b. Tom shattered the bottle into pieces.
c. The cook froze the soup solid.

[6] In addition to the original diagnostic by RHL, i.e. denying that the result state named by the verb holds of a patient, I also make use of the diagnostic as implemented in Beavers (2011), namely *something is different about x*, in order to capture that a participant has undergone a more general change. As noted by Beavers and Koontz-Garboden (2012: 357), the original diagnostic by RHL could be subject to the criticism that this diagnostic does not show that all result verbs encode the "same notion of result." Hence, the *something is different about x* diagnostic by Beavers (2011) identifies a notion of change/result which is not specific to a particular verb.

(10) a. *John broke the vase off the table.
b. *Tom shattered the bottle valueless.
c. *The cook froze the soup onto the table.

This limitation in the types of result phrases permitted by result verbs follows from the grammatical restriction that a single entity cannot undergo two distinct result states along different dimensions at the same time, i.e. the Unique Path Constraint by Goldberg (1991) (but see also Tenny, 1994; Levin and Rappaport Hovav, 1995; Tortora, 1998; Matsumoto, 2006). Goldberg (1991) argues that two different result states (paths in her terminology) cannot be predicated of the same entity within the same clause. This is supported by the fact that result verbs combined with result phrases introducing a distinct result state than the one encoded by the verb (11) or two result phrases describing distinct result states along different dimensions predicated of the same entity (12) are not possible combinations.[7]

(11) a. *Sally carried John giddy. (Simpson, 1983: 147)
b. *Bill broke the vase worthless. (Jackendoff, 1990: 240)
c. *The vase fell broken. (Rappaport Hovav, 2014: 23)

(12) a. *Sam kicked Bill black and blue out of the room. (Goldberg, 1991: 368)
b. *He wiped the table dry clean. (Goldberg, 1991: 370)
c. *Sam tickled Chris off her chair silly. (Goldberg, 1991: 368)

The last result diagnostic by RHL relates to the possibility of permitting nonselected objects and object deletion, as briefly discussed before. In this respect, recall that RHL claim that whereas manner verbs permit object deletion as well as nonselected objects, result verbs do not.[8] This is illustrated in more detail in (13): manner verbs permit nonselected objects (13a) (as well as the *way*-construction (13b) and fake reflexives (13c)) and constructions that involve the deletion of the object (i.e. *out*-prefixation (13d)), apart from simply allowing the deletion of the object (13e), whereas this is argued not to be possible with result verbs (14).

(13) a. The joggers ran the pavement thin. (Levin and Rappaport Hovav, 1995: 52)
b. I kicked my way across the beach. (COCA)
c. John worked himself tired.
d. John outscrubbed Tom.
e. All last night, John swept.

(14) a. *The toddler broke his hands bloody. (RHL p. 22)
b. ?John shattered his way into the vault.
c. *John murdered himself tired. (to mean John murdered people until he became tired) (adapted from Goldberg, 2001)
d. ??Kim outshattered the other bottle-shatterer. (Beavers and Koontz-Garboden, 2012: 339)

[7] As Beavers and Koontz-Garboden (2012: 340) note, the examples in (11) are not pragmatically impossible, since there could be scenarios in which, for instance, Sally carries John, and as a result of the carrying, John becomes giddy, yet these scenarios cannot be described by means of a result verb and a result phrase.

[8] Goldberg (2001) notes that result verbs do permit nonselected objects and object deletion, but only in generic or habitual sentences (e.g. *Tigers only kill at night)*; crucially, though, manner verbs are not restricted in this sense. In light of this, RHL (p. 21) argue that "while manner verbs are found with unspecified and non-subcategorized objects in non-modal, non-habitual sentences, result verbs are not."

e. All last night, John killed *(the criminals at that prison).

In this respect, as Beavers and Koontz-Garboden (2012) note, Rappaport Hovav (2008: 24) proposes that disallowing object deletion follows from the fact that result verbs lexicalize scales of change, and therefore Rappaport Hovav suggests that scales "require that the participant whose property is measured by them be overtly realized." It follows, then, that result verbs do not permit object deletion, since this would involve that the participant whose property is being measured out is not overtly expressed. Similarly, from this it also follows that result verbs disallow nonselected objects since such objects involve the deletion of the 'true' object.

In a similar vein, Levin (2017: 583) argues that the objects of result verbs must be expressed "because to know that a state holds requires looking at the entity it holds of", what she calls the 'patient realization condition.' Levin further argues that in an event of scalar change, the patient whose property is being measured out "must be expressed due to the patient realization condition and further it must be expressed as an object." From this it follows then that, as Levin (p. 584) argues, result verbs "cannot be found with unspecified objects or nonselected objects, nor can they be found in constructions where anything but their patient argument is the object."

In short, RHL strongly argue that if a verb encodes a result state predicated of a participant, such participant must be given syntactic expression. As Beavers and Koontz-Garboden (2012) note, this constraint might follow from Rappaport Hovav and Levin's (2001: 779) Argument-Per-Subevent Condition:

(15) **Argument-Per-Subevent Condition**: There must be at least one argument XP in the syntax per subevent in the event structure.

In this respect, manner and result verbs differ with regard to the subevents they involve: manner verbs are simplex in the sense that they are only assigned one subevent (16a), whereas (transitive) result verbs are more complex insofar as they are composed of two different subevents (16b), i.e. the causing event and the change-of-state event.

(16) a. [x ACT <ROOT>]
b. [[x ACT] CAUSE [y BECOME <ROOT>]]]

Consequently, according to the Argument-Per-Subevent Condition, in result verbs the patient whose property is measured out must be expressed, since a result state involves a change-of-state (i.e. BECOME) subevent of which the patient is the unique participant. Similarly, object deletion and nonselected objects are found with manner verbs since manner verbs do not encode a result state and therefore manner verbs do not have that additional subevent.

3. The *way*-construction in English

The *way*-construction in English is a long-studied construction (Levin and Rapoport, 1988; Salkoff, 1988; Jackendoff, 1992; Marantz, 1992; Tenny, 1994; Goldberg, 1995, 1996; Israel, 1996; Kuno and Takami, 2004, *i.a.*) that consists of a verb taking as its complement a noun phrase comprised of a possessive determiner, coreferential with the subject, and the noun *way*. This noun phrase headed by *way* is followed by a directional phrase, which is usually a prepositional phrase, but can also be an adverb phrase, describing a path, either metaphorical (17) or physical (18), usually created by the action denoted by the verb. Semantically, the interpretation of this construction entails that the entity denoted by the subject traverses this path, as shown in (17).

(17) a. Tom slept his way to the top, #but didn't get to the top.
b. Emma built her way to success, #but didn't achieve success.

(18) a. Nigel danced his way *(out of the theater).
b. Tod elbowed his way *(through the crowd).

The noun phrase headed by *way* in this construction is a clear case of a nonselected object (Levin and Rappaport Hovav, 1995), i.e. an object that is nonselected by the verb. As Mateu (2002) notes, it is actually the directional phrase that requires the realization of the noun phrase headed by *way* as the direct object, not the verb, as shown in (18).

More specifically, Marantz (1992) argues that the *way*-construction in English is a diagnostic to tell unaccusative and unergative verbs apart since only unergative verbs are claimed to appear in this construction. Levin and Rappaport Hovav (1995: 137) further argue that unaccusative verbs are not found in the *way*-construction since "they lack the ability to assign Case to a postverbal NP [noun phrase]." This is related to Burzio's (1986) claim that only unergative verbs can assign case to their subjects and consequently they can also assign accusative case, despite not subcategorizing for any object. Hence, since unergative verbs have the ability to assign accusative case, they can be found with objects that are not selected by the verb (e.g. *John ran his shoes ragged*). As a consequence, unergative verbs are found in the *way*-construction since, despite not subcategorizing for any object, they can assign accusative case to the nonselected noun phrase headed by *way*. Unaccusative verbs on the other hand are not case assigners and therefore would fail to assign case to the noun phrase headed by *way*. Burzio argues that the unability of unaccusative verbs to assign case correlates with the occurrence of an external argument, since only verbs that can assign case to their subjects can assign accusative case. As noted above, this appears to be a correct generalization since canonincal unaccusative verbs are never found in the *way*-construction. Consider the further examples from Levin and Rappaport Hovav (1995: 148, 150).

(19) a. *Andrea appeared her way to fame.
b. *The water evaporated its way into the air.
c. *The oil rose its way to the top.

However, following Kuno and Takami (2004), I contend that *roll* verbs (i.e. *roll*, *slide*, *spin* and *whirl*) are unaccusative (following Rappaport Hovav, 2014) and yet appear in the *way*-construction, thus suggesting that unaccusativity may not be the relevant notion constraining the verb classes permitted by the construction. Some further examples are offered next.

(20) a. An enormous snowball slowly rolled its way towards him. (GBooks)
b. Sandy was whirling its way toward the U.S. coastline. (COCA)
c. The wheel spun its way to a standstill. (GBook)
d. I'm actually asking this young lady to sort of slide her way out the door. (COCA)

In order to further show that *roll* verbs are unaccusative in their intransitive variant, I briefly make use of some of the widely accepted unaccusative diagnostics in the literature to tell unaccusative and unergative verbs apart. For instance, it has been argued that unaccusative verbs are found in the so-called *there*-construction (21) (Burzio, 1986; Belletti, 1988; Lumsden, 1988;

Levin and Rappaport Hovav, 1995, *i.a.*), whereas unergative verbs are not (22).

(21) a. There could have occurred a disaster.
b. There appeared a really tall man at the door.
c. There arrived the men you had been waiting for.

(22) a. *There danced two ballerinas on the stage.
b. *There played two children on the street.
c. *There worked two farmers inside the farm.

In this respect, *roll* verbs pattern like unaccusative verbs as they are found in the *there*-construction, as shown in the following examples (from GBooks).

(23) a. In Sandy's head there whirled a confusing medley of the two lives she had lived.
b. And on the screens, there spun a kaleidoscope of whirling dancers in garish colors.
c. Over the whole sky there rolled great masses of cloud of a deep copper colour.
d. She cut it open and there slid on the table oilcloth five gold coins.

Another unaccusative/unergative diagnostic relates to the fact that result phrases can be predicated directly of the subjects of unaccusative verbs without introducing a fake reflexive in object position, as shown in (24) (Simpson, 1983; Bresnan and Zaenan, 1990; Hoekstra, 1984, 1988; Levin and Rappaport Hovav, 1995, *i.a.*), whereas result phrases cannot be predicated of the subjects of unergative verbs without introducing a fake reflexive in object position, as shown in (25).[9]

(24) a. The river froze solid.
b. The vase broke into pieces.
c. The earth split open. (Winkler 1997: 342)

(25) a. The CEO worked *(herself) tired.
b. The singer sang *(himself) hoarse.
c. The children laughed *(themselves) silly.

In this respect, *roll* verbs further show unaccusative behavior when subject to this diagnostic.

(26) a. The door whirled open. (GBooks).
b. As the doors roll shut and lock behind him. (COCA)
c. He screams. Tries to spin free. (COCA)
d. The little window in the front cab slid closed. (COCA).

Lastly, it has been argued that unaccusative verbs are not generally found with cognate objects (Levin and Rappaport Hovav, 1995; Massam, 1990; Larson, 1988; Keyser and Roeper, 1984;

[9]It has been argued that result phrases can only be predicated of objects, not of subjects (Levin and Rappaport Hovav, 1995; Rappaport Hovav and Levin, 2001). However, since the subjects of unaccusative verbs are supposedly underlying objects (as held by proponents of the Unaccusative Hypothesis (Perlmutter, 1978; Burzio, 1986)), result phrases can be predicated directly of the subjects of unaccusative verbs. The subjects of unergative verbs, on the other hand, are not underlying objects at any level, and therefore a fake reflexive in object position must be introduced so that the result phrase is predicated of this fake reflexive object position, correferential with the subject (Rappaport Hovav and Levin, 2001).

Macfarland, 1995; Miyamoto, 1999), as illustrated by the examples in (27) (from Levin and Rappaport Hovav, 1995: 40, 148). Unergative verbs, on the other hand, permit them (28).

(27) a. *The glass broke a crooked break.
b. *She arrived a glamorous arrive.
c. *The apples fell a smooth fall.

(28) a. Malinda smiled her most enigmatic smile. (Levin and Rappaport Hovav, 1995: 40)
b. Sue slept a sound sleep. (Kuno and Takami, 2004: 105)
c. John laughed a bitter laugh.

Roll verbs further pattern like unaccusative verbs as they do not generally permit cognate objects.

(29) a. ??The ball rolled a smooth roll.
b. ??The tornado whirled a quick whirl.
c. ??The wheel spun a slow spin.
d. ??The athlete slid a wonderful slide.

In short, *roll* verbs are unaccusative in their intransitive variant and yet are found in the *way*-construction, thus showing that unaccusativity does not seem to be the relevant notion constraining the verb classes permitted by this construction. As I argue in Section 5, the unaccusative *roll* verb class is found in the *way*-construction since they do not encode a result state. Canonical unaccusative verbs such as *arrive*, *die* or *disappear*, on the other hand, encode a result state predicated of the subject referent, and therefore incompatible with the *way*-construction as per the Unique Path Constraint (Goldberg, 1991), as this would involve that two different result states would be predicated of the same entity, i.e. the result state denoted by the construction and the result state encoded by the verb would be predicated of the same subject.

In a similar vein, recall that result verbs should not be found in the *way*-construction either, as this is a case of a nonselected object construction. However, this does not appear to be the case since I show that result verbs frequently appear in the *way*-construction as illustrated by the following examples.

(30) a. We cannot kill our way out of this war. (COCA)
b. The prisoner probably melted his way out. (GBooks)
c. They tried to burn their way into something with a cutting torch. (COCA)
d. Looters smashed their way in and went on a digging spree. (COCA)

In this respect, note what Rappaport Hovav (2017: 96) has recently argued with regard to result verbs and the *way*-construction:

> [...] the *way*-construction generally selects manner verbs because it is supposed to specify the kind of action which brings about or accompanies a certain COS [change of state verbs] (Goldberg, 1995). Precisely because result verbs do NOT specify any manner of action, they typically do not appear in this construction. Only in heavily contextualized environments, where the action can easily be recovered, are COS verbs compatible with this construction.

In short, it appears that, according to Rappaport Hovav, result verbs can be found in the *way*-construction in some exceptional cases. In the next section, however, I argue that this does not appear to be the case since I show that instances of result verbs in the *way*-construction can have inanimate entities as their subjects. Inanimate subjects are, by definition, incompatible with the carrying out of an action to bring about a change-of-state, as this is typical of (animate) agent subjects. Further, the fact that, as I show, different result verbs frequently appear in this construction strongly suggests that result verbs do not appear to be constrained in the sense Rappaport Hovav argues.

4. The elasticity of result verbs revisited

In this section, I focus on different result verbs which, over the last twenty-five years, RHL have, to some extent, presented as examples of canonical result verbs, e.g. *kill*, *melt*, *burn*, *smash*, *slaughter*, *break*, *shatter*, *freeze*, *crush*, *rip*, *tear*, *open*, *destroy*, *cool* and *crack*, in order to argue that result verbs permit nonselected objects in some cases, contra RHL. All these verbs pattern as result verbs when subject to the diagnostics laid out by RHL, i.e. denying that a change has occurred results in a contradiction (cf. *John just killed Tom, #but he is not dead/#but nothing is different about Tom*), they only allow result phrases that further specify the result state they encode (cf. *John broke the vase into pieces* vs. **John broke the vase off the table*) and they do not permit object deletion (cf. **All last night, John smashed/melted/shattered*).

Recall that *way*-construction in English entails that the subject referent traverses the path described by the construction, i.e. this construction denotes a change-of-location predicated of the subject referent. In this respect, manner verbs, insofar as they do not encode a result state, are frequently found in this construction since in this case only one result state is being predicated of the subject referent, i.e. the one denoted by the construction, and therefore the grammatical restriction on the number of result states predicated of the same entity (i.e. the Unique Path Constraint) is not violated.

(31) a. John just kicked his way into the concert, #but he is not somewhere else/#but he is not at the concert.
  b. John just elbowed his way out of the theater, #but he is not somewhere else/#but he is not out of the theather.
  c. John just talked his way into the meeting, #but he is not somewhere else/#but he is not in the meeting.

Result verbs, on the other hand, appear to more restricted than manner verbs with regard to appearing in the *way*-construction since they do encode a result state. In this respect, I argue that result verbs are frequently found in the *way*-construction when the result state they encode is predicated of an object that, while not being overtly realized, is semantically implicit.

(32) a. Similar to modern birds and reptiles, dinosaur young cracked their way out of eggs. (GBooks)
  b. Spartacus wanted to engage Crassus in battle, slaughtering his way toward the general's position. (COCA)
  c. The group of 6 destroyed their way out of the lab and made it to the ground floor. (Web)
  d. I spent hours with a frail woman while opening our way through a set of Russian

dolls. (COCA)

e. You might switch to the knight to crush your way through a barrier. (Web)

More specifically, by 'unexpressed object' I mean the object that, while not being syntactically expressed (as the object position is occupied by the nonselected noun phrase headed by *way*), undergoes the result state encoded by the verb. This is in line with Goldberg's (2001: 509) argument that result verbs are still causative verbs when they are used in this construction, since, as shown in the examples below, one cannot, for instance, kill their way out of prison without causing people to die. In a similar vein, Rappaport Hovav (2017: 96) further notes that result verbs "maintain [their] truth-conditional content as a result root" when they are found in this construction. This is illustrated in the following examples where it cannot be denied that the unexpressed objects do not undergo the result state encoded by the verb.

(33) a. Theatre's annual summer melodrama is about a harsh Victorian Duke who has killed his way to power, #but nobody was killed/#but nobody died. (COCA)

b. Yet, once more, while he broke his way among the branches, the traveller lost his friend, #but the branches weren't broken/#but nothing was broken. (COCA)

c. The dragons might simply burn their way out of the netting, #but the netting might not be burned/#but nothing might be burned. (COCA)

The fact that result verbs only appear in the *way*-construction when the result state they encode is predicated of an unexpressed object follows from the grammatical restriction that, as held by the Unique Path Constraint, two different result states cannot be predicated of the same entity. In other words, result verbs are found in the *way*-construction when the result state they encode is predicated of an unexpressed object, while the result state denoted by the construction is predicated of the subject referent. In this way, the limitation on the number of result states that can be predicated of the same entity is not violated. This is illustrated in the following example.

(34) a. *The wood burns its way to the ground. (Goldberg, 1996: 45)

b. William T. Sherman burned his way through Georgia and then did more damage in the Carolinas. (GBooks)

Thus, I argue that the example in (34a) is ungrammatical due to the fact that two distinct result states are being predicated of the same entity. Namely, in (34a) it is understood that the entity denoted by the subject both burns and ends up on the ground, i.e. the result state denoted by the construction and the verb are being predicated of the same entity. Instead, the same (result) verb is found in the *way*-construction when the result state encoded by the verb is predicated of an object that is not given syntactic expression, but is semantically implicit, as argued before. In this respect, no restriction arises with regard to the number of result states that can be predicated of the same entity, since the two distinct result states, i.e. the one encoded by the verb and the one denoted by the construction, are predicated of distinct entities. Namely, in (34b) the result state denoted by the construction is predicated of the entity denoted by the subject (i.e. *William T. Sherman*), whereas the result state encoded by the verb is predicated of the unexpressed, but semantically implicit, object (cf. *William T. Sherman burned his way through Georgia, #but Giorgia wasn't burned*).

Although Rappaport Hovav (2008: 24) argues that result verbs are not found in nonselected object constructions since most of these constructions "involve the introduction of a new scale" and therefore "ruled out with change of state verbs by the constraint against more than one scale in a clause", this does not appear to be the case. The grammatical restriction in the number of scales is actually a restriction on the number of scales predicated of the same entity (already hinted at by Levin and Rappaport Hovav, 1995: 60 and further argued in Beavers and Koontz-Garboden, 2017: 868-70). This is supported by the fact that, as already shown in (34b), result verbs do appear in the *way*-construction when the result state they encode and the result state denoted by the construction are not predicated of the same entity. Additional examples further support this claim.

(35) a. *The soup cooled its way to room temperature. (Levin and Rappaport Hovav, 1995: 173)
b. The brew cooled its way down her throat as she cast her eyes around the bar. (Web)

(36) a. *The window broke its way into the room. (Jackendoff, 1992: 213)
b. The snow must have frozen so hard during the night that he couldn't break his way out. (COCA)

(37) a. *The butter melted its way off the turkey. (Godberg, 1996: 45)
b. For perhaps an hour the ray melted its way into the solid rock. (GBooks)

Lastly, recall that Rappaport Hovav (2017) argues that result verbs are found in this construction when an "action can be easily recovered." I show, however, that this does not appear to be the case since result verbs are also found in the *way*-construction with inanimate entities as their subjects. This is relevant since inanimate subjects are, by definition, not compatible with performing an action to bring about a change-of-state, since this is typical of (animate) agent subjects.

(38) a. The cold froze its way into her skull and eye sockets like a razor. (Web)
b. Several more explosions ripped their way along the street, blowing a group of old people into a bloody heap. (GBooks)
c. Radiation and chemo tore their way through Jeff, sores opened up all over his body. (COCA)
d. Over 800 lightning strikes this afternoon shattered their way into central California. (Web)
e. The heat of the 1 million candle stick powered light melted its way through the resin floor of the ambulance. (GBooks)
f. [...] a fire which burnt its way into the computer networks room from outside. (GBooks)

In short, I have argued that result verbs can permit nonselected objects in some cases, thus showing that result verbs appear to be more elastic with regard to argument realization than previously claimed, contra RHL.

5. The elasticity of unaccusative verbs revisited

As we have observed, unaccusativity does not seem to be the restriction in place in the *way*-construction, since unaccusative verbs of the *roll* sort are found in this construction.

(39) a. Our 8,000 ton ship rolled its way down the English Channel to the Atlantic. (GBooks)
b. I slid my way up to the top and when I got there, I could see. (COCA)
c. The egg-shapped pod spun its way down to the earth's surface. (GBooks)
d. The snow storm known as Winter Storm Santa has whirled its way across the Mid-Atlantic. (GBooks)

Although it is the case that most unaccusative verbs are not permitted in this construction, I argue that this is due to the fact that the unaccusative verbs that are not permitted encode a result sate, not due to being unaccusative. Canonical unaccusative verbs such as *arrive*, *die*, *bloom*, *flower* or *come* encode a result state predicated of the subject referent, and therefore are not found in the *way*-construction since integrating this type of unaccusative verbs in this construction would involve that two different result states are predicated of the same entity, which has been argued not to be grammatically possible, i.e. the Unique Path Constraint. As shown in the following examples, canonical unaccusative verbs pass the result diagnostics laid out by RHL, i.e. denying that a change has occurred results in a contradiction (40) and they are restricted in the types of result phrases permitted, as they only permit result phrases that further specify the result state encoded (41).[10]

(40) a. The flower just bloomed, #but nothing is different about it.
b. Tony just came to Paris, #but he is not somewhere else.
c. John just died, #but nothing is different about him.

(41) a. The box arrived at the aiport/*open. (to mean arrival caused the box to open) (Goldberg, 1991: 371)
b. She ascended to the sky/*sick. (to mean ascension made her sick) (Goldberg, 1991: 371)
c. The vase fell off the table/*broken. (to mean falling caused it to break). (Rappaport Hovav, 2014: 276)

Thus, in accordance with the grammatical restriction that no more than one distinct result state can be predicated of the same entity within the same clause, unaccusative verbs encoding a result state are not compatible with the *way*-construction. In contrast, the unaccusative *roll* verb class displays different properties since I argue, following Rappaport Hovav (2014) and RHL, that *roll* verbs do not encode a result state, and consequently unaccusative *roll* verbs can be found in the *way*-construction.[11]

More specifically, if *roll* verbs do not encode a result state, they should be compatible with a wide range of distinct result phrases, as argued by RHL. The facts bear this out, as *roll* verbs are compatible with a wide range of result phrases that introduce different result states (see Rappaport Hovav, 2014: 273-78 for further examples with *roll*, as well as the examples in (26)).[12]

[10] The diagnostic related to object deletion cannot be applied with result verbs of the *arrive* sort since this is an intransitive verb class and this diagnosic was laid out to be applied to transitive result verbs.
[11] Rappaport Hovav (2014) argues that verbs of the *roll* sort only encode a manner of motion, since the change they specify is not directed, i.e. they encode nonscalar changes as they do not lexically specify any scale of change.
[12] Although some of these examples show the transitive variants of these verbs, these are still relevant insofar as they further show that these verbs do not appear to encode a result state, neither of their subject in their intransitive

(42) a. The briefly rolled free of one another. (COCA)
b. Tom [...] hit his head on a rock and rolled unconscious. (Web)
c. Adam rolled awake at the first light of peeping past the half-open curtains. (GBooks)

(43) a. They had been literally whirled unconscious at the end of their subterranean flight. (GBooks)
b. It dries by the centrifugal process, the cloths being literally whirled dry. (GBooks)
c. [...] hope he gets whirled silly in a revolving door or something. (Web)

(44) a. Prepare the salad greens, wash and spin dry. (COCA)
b. [...] and they Kurds spin loose and join with the Kurds in Turkey. (COCA)
c. He wanders inside an ancient stone tower and is spun unconscious by a blinding tornado of green light. (Web)

(45) a. He struck the wall with a crunch, and slid unconscious to the ground. (GBooks)
b. She slid free, dropped to her knees again, [...]. (COCA)
c. The second block slid loose from its case. (COCA)

In addition, if *roll* verbs do not encode any result state, denying that a change has occurred should not result in a contradiction, as no result state is encoded (cf. *John just ran (in place), but he is not somewhere else*). In this respect, I note that *roll* verbs are compatible with the *x is somewhere else* test by Beavers (2011) which identifies verbs that encode changes of location. In contrast, unaccusative verbs encoding a result state related to a change of location are not compatible with the same diagnostic, as previously shown in (40b).

(46) a. The tornado just whirled, but it is not somewhere else.
b. The disc just spun, but it is not somewhere else.

(47) a. The students just arrived (in London), #but they are not somewhere else.
b. The thief just left (the house), #but he is not somewhere else.

Beavers and Koontz-Garboden (2017: 863) however argue that *roll* and *slide* are scalar change verbs, i.e. they encode a result state, since it is not possible to *roll* or *slide* in place or without leaving one's spot (cf. *#John slid/rolled in place/without leaving his spot*). I suggest that this apparent displacement is due to world knowledge, since real-world events of rolling or sliding are generally followed by displacement. On closer inspection, however, it is possible to find naturally occurring examples of events of rolling or sliding that do not seem to entail any displacement.

(48) a. The meteor appears to be rolling in place on its axis–rather than toward us. (Web)
b. One really cool effect that I've seen a bunch is one where an image seems to be sliding in place when you hover over it using your mouse. (Web)

In addition, Beavers and Koontz-Garboden (2017: 867) further argue that *roll* and *slide* encode a scalar change since only goal prepositonal phrases are acceptable as result phrases, whereas "other kinds of result phrases are generally unacceptable." However, both *roll* and *slide* appear to permit a wide range of result phrases, as shown in (42) and (45), therefore suggesting that they pattern like manner verbs in this respect.

variant nor of their object in the transitive variant.

In short, unaccusative *roll* verbs do not appear to encode a result state (in the sense of RHL) since they are compatible with a wide range of result phrases and denying that a change has occurred does not result in a contradiction, in contrast to canonical unaccusative verbs encoding a result state. Consequently, this explains why unaccusative verbs show variable behavior with regard to permitting the *way*-construction or not: under the present analysis, unaccusative verbs of the *roll* sort are predicted to be found in this construction, whereas unaccusative verbs of the *arrive* sort are not. Some more naturally occurring examples of *roll* verbs in the *way*-construction are offered next.

(49) a. Some chose to roll their way under it other decided to crawl. (COCA)
b. The deep ocean currents whirling their way into the Arabian Sea. (COCA)
c. The warrior watched as the ball of fire spun its way higher into the tent. (GBooks)
d. A cable car [...] slid its way down slowly from the cableway station. (GBooks)

6. Conclusion

In the present paper, I have shown that both result and unaccusative verbs appear to be more elastic with regard to argument realization than previously claimed. Regarding result verbs, I have argued that they permit nonselected objects in some cases, contra RHL. In this respect, I have shown that result verbs are found in the *way*-construction when the result state they encode is predicated of an unexpressed object, thus avoiding the limitation in the number of distinct result states that can be predicated of the same entity. With regard to the unaccusative verb class, I have argued that unaccusative verbs are found in the *way*-construction when they do not encode a result state, thus showing that unaccusativity is not the relevant constraint imposed by the construction on the verb classes it permits, contra Marantz (1992), Levin (1993) and Levin and Rappaport Hovav (1995).

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Reverse proportionality without context dependent standards[1]

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Abstract. In the so-called *reverse proportional reading* (Herburger, 1997), the truth conditions of statements of the form *many/few* ϕ ψ appear to make reference to the ratio of the individuals that are in the extensions of both ϕ and ψ to the individuals that are in the extension of ψ. The analysis of such readings is controversial. One prominent approach (Büring, 1996; de Hoop and Solà, 1996; Romero, 2015, 2016; Solt, 2009) assumes that they are a symptom of *many* and *few* making reference to a context dependent standard of comparison. Elaborating on remarks in Partee (1989), we observe that this initially attractive approach systematically undergenerates, failing to capture pervasive reverse proportionality in environments that remove context dependency of the standard. Instead, we propose that reverse proportionality in such cases reflects the underspecification of the measure function underlying the meanings of *many* and *few* (Bale and Barner, 2009; Wellwood, 2014; Solt, 2018).

Keywords: proportional quantifiers, *many* and *few*, reverse proportionality, comparatives, degree constructions, measure functions, context dependency.

1. Introduction

Since Partee (1989), much work has assumed that *many* and *few* are lexically ambiguous between a *cardinal* and a *proportional* sense. Under the cardinal meaning, the truth of *many/few* ϕ ψ requires that the cardinality of $[\![\phi]\!] \cap [\![\psi]\!]$, the intersection of the extensions of ϕ and ψ, be above/below a contextually determined standard cardinality; under the proportional meaning, it requires that the ratio of individuals in $[\![\phi]\!] \cap [\![\psi]\!]$ to individuals in $[\![\phi]\!]$ is above/below a contextually determined standard proportion. This lexical ambiguity is posited to capture the range of interpretations that is illustrated for *few* by Partee's examples in (1).

(1) a. There were few faculty children at the 1980 picnic.
b. Few egg-laying mammals suckle their young

Partee presents (1a) as illustrating the cardinal sense of *few*. The sentence can be judged true even if *all* of the faculty children were at the 1980 picnic, on the grounds that at the time there were only few faculty children to begin with. This suggests that the sentence portrays the cardinality of the intersection of $[\![$*faculty children*$]\!]$ and $[\![$*at the party*$]\!]$ as falling below a contextually determined standard. In contrast, Partee reports that truth conditions of (1b) do not impose similar requirements. Unlike the reading in (1a), the sentence in (1b) cannot be true if all the egg-laying mammals suckle their young, even if there are only a few egg-laying mammals existing in the world. Instead, the sentence is read as being about the ratio of individuals in that intersection to individuals in $[\![$*egg-laying mammals*$]\!]$, portraying that ratio as falling below a contextually determined standard. Hence Partee takes (1b) to illustrate the proportional sense of *few*.

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In the proportional reading identified by Partee (1989), the proportion that *many/few* $\phi\ \psi$ refers to, namely $|\llbracket\phi\rrbracket \cap \llbracket\psi\rrbracket|/|\llbracket\phi\rrbracket|$, has a denominator determined by the nominal argument. Refining the standard terminology, we refer to this reading as the *forward* proportional reading. We use this terminology to distinguish it from the *reverse* proportional reading that is the focus of our investigation. The reverse proportional reading, first discussed in Westerståhl (1985b), is best illustrated by the sentence in (2), taken from Herburger (1997).

(2) Few cooks applied.

Herburger reports that this sentence can be read as a statement about the ratio of the set of applicants that are cooks, the intersection of $\llbracket cooks \rrbracket$ and $\llbracket applied \rrbracket$, to the set of applicants, $\llbracket applied \rrbracket$, stating that this ratio is below a contextually determined standard. In this reading, the proportion that *many/few* $\phi\ \psi$ refers to is $|\llbracket\phi\rrbracket \cap \llbracket\psi\rrbracket|/|\llbracket\psi\rrbracket|$, where the denominator is now determined by the *scope* of the quantifier that *many/few* forms, rather than by the noun phrase that serves as its restrictor.

The existence of reverse proportional readings of sentences with *many* and *few* appears to be beyond dispute. What is debated, however, is the analysis of such readings. Driven in part by considerations of theoretical parsimony, most authors reject Westerståhl's (1985b) assumption that reverse proportional readings are due to a reverse proportional lexical meaning of *many* and *few*. In one prominent school of thought, which we will refer to as the *standard-based* approach to reverse proportionality (Büring, 1996; de Hoop and Solà, 1996; Romero, 2015, 2016; Solt, 2009), reverse proportional readings are instead a symptom of *many* and *few* making reference to a context dependent standard of comparison, and are a natural consequence of this context dependency, under appropriate conditions, even in the absence of reverse proportional lexical entries for *many* and *few*.

However, the main objective of this paper is to demonstrate, elaborating on remarks in Partee (1989), that the standard-based approach systematically undergenerates, as it fails to capture pervasive reverse proportionality in environments that remove context dependency of the standard of comparison (section 3). Moreover, we aim to motivate an alternative, novel, approach to reverse proportionality in such cases, proposing that it reflects the underspecification of the measure function underlying the meanings of *many* and *few* (Bale and Barner, 2009; Wellwood, 2014; Solt, 2018; section 4). To set the stage for these arguments, we begin by spelling out in more detail the two analyses of reverse proportionality hinted at above, the lexical ambiguity analysis and the standard-based analysis (section 2).[2]

2. Reverse proportionality from context dependent standards

The literature develops the standard-based approach into different detailed analyses that diverge on important particulars (Büring, 1996; de Hoop and Solà, 1996; Romero, 2015, 2016; Solt, 2009). However, since our argument will apply to the standard-based approach as a whole, there is no need here for a comprehensive review of these different proposals. We will instead

[2]In this paper, we do not address the interactions between syntax, semantics and focus structure with regards to the interpretation of *many* and *few*. As far as we can see, the conclusions we reach in this paper stand regardless of how these issues are resolved. Given that we discuss readings previously unexplored in the literature, future work will have to explore how the new range of semantic interpretations interact with these factors. For a discussion of these interactions, see Büring (1996), de Hoop and Solà (1996), Cohen (2001), Herburger (1997), Partee (1989), Romero (2015, 2016), among others.

introduce this general approach by outlining one particular possible rendition. This rendition is discussed (although ultimately not endorsed) in Westerståhl (1985b), and it also follows closely the line of reasoning developed in Solt (2009).

As a baseline, we first define the family of lexical entries that captures the two types of readings associated with *many* and *few* that Partee (1989) argued for. Treating *many* and *few* as forming generalized quantifiers in the sense of Barwise and Cooper (1981), the cardinal and forward proprotional sense of *many* and *few* are given in (3) and (4), where n and p are contextually given standards of cardinality and proportion, respectively.

(3) a. $[\![\mathit{many}_1]\!](\mathrm{X})(\mathrm{Y}) \Leftrightarrow |\mathrm{X} \cap \mathrm{Y}| > \mathrm{n}$
b. $[\![\mathit{few}_1]\!](\mathrm{X})(\mathrm{Y}) \Leftrightarrow |\mathrm{X} \cap \mathrm{Y}| < \mathrm{n}$

(4) a. $[\![\mathit{many}_2]\!](\mathrm{X})(\mathrm{Y}) \Leftrightarrow |\mathrm{X} \cap \mathrm{Y}|/|\mathrm{X}| > \mathrm{p}$
b. $[\![\mathit{few}_2]\!](\mathrm{X})(\mathrm{Y}) \Leftrightarrow |\mathrm{X} \cap \mathrm{Y}|/|\mathrm{X}| < \mathrm{p}$

Following Westerståhl (1985b), reverse proportional readings could be captured in a straightforward way by positing the pair lexical entries in (5), obtained from those in (4) by replacing the first set argument with the second in the denominator of the fraction that the truth conditions refer to.

(5) a. $[\![\mathit{many}_3]\!](\mathrm{X})(\mathrm{Y}) \Leftrightarrow |\mathrm{X} \cap \mathrm{Y}|/|\mathrm{Y}| > \mathrm{p}$
b. $[\![\mathit{few}_3]\!](\mathrm{X})(\mathrm{Y}) \Leftrightarrow |\mathrm{X} \cap \mathrm{Y}|/|\mathrm{Y}| < \mathrm{p}$

However, as also noted by Westerståhl (1985b), given that the standard proportion p in these meanings is context dependent, it can be argued that conventionally encoded reference to reverse proportions is dispensable. This is because the right sides of the equivalencies in (5) can be restated as in (6).

(6) a. $|\mathrm{X} \cap \mathrm{Y}|/|\mathrm{Y}| > \mathrm{p} \;\Leftrightarrow\; |\mathrm{X} \cap \mathrm{Y}| > \mathrm{n}$, where $\mathrm{n} := \mathrm{p} \times |\mathrm{Y}|$
b. $|\mathrm{X} \cap \mathrm{Y}|/|\mathrm{Y}| < \mathrm{p} \;\Leftrightarrow\; |\mathrm{X} \cap \mathrm{Y}| < \mathrm{n}$, where $\mathrm{n} := \mathrm{p} \times |\mathrm{Y}|$

Indeed, as Westerståhl (1985b) observes, the forward proportional readings, too, could be accounted for by manipulating the contextual standard, as shown in (7).

(7) a. $|\mathrm{X} \cap \mathrm{Y}|/|\mathrm{X}| > \mathrm{p} \;\Leftrightarrow\; |\mathrm{X} \cap \mathrm{Y}| > \mathrm{n}$, where $\mathrm{n} := \mathrm{p} \times |\mathrm{X}|$
b. $|\mathrm{X} \cap \mathrm{Y}|/|\mathrm{X}| < \mathrm{p} \;\Leftrightarrow\; |\mathrm{X} \cap \mathrm{Y}| < \mathrm{n}$, where $\mathrm{n} := \mathrm{p} \times |\mathrm{X}|$

Thus, *many* and *few* could have a univocal, cardinal meaning with polysemy rooted in an independently motivated contextually determined standard.[3]

This theoretically parsimonious option places the burden of proof on those wishing to argue for the existence of forward and reverse proportional lexical senses like those defined in (4) and (5).[4] Here we focus on the reverse proportional reading, though, which is also the one that is

[3]Even in a language where cardinal and proportional meanings are lexicalized differently, the two expressions corresponding to *many* might differ merely in terms of how their syntax interacts with the mechanism of fixing the standard of comparison. Krasikova (2011) argues this very point for Russian *mnogie* and *mnogo*, which correspond to proportional and cardinal *many*, respectively.

[4]Westerståhl (1985b) warns against such an appeal to parsimony, noting that this would require enriching our semantics so that multiple contextual standards could be set within the same sentence. For example, Westerståhl (1985b) cites Barbara Partee's example *Many boys date many girls*, where it is apparent that the contextual standard of what counts as *many* in the first DP is much higher than what counts as *many* in the second. However,

more commonly collapsed into a cardinal interpretation.[5]

Accepting this burden of proof, we will now proceed to establish that reverse proportionality is not in fact dependent on the presence of a contextually determined standard of comparison. While we do not know of any reasons, empirical or conceptual, for assuming that reverse proportionality can *never* be due to a particular setting of the standard, we will see that standard setting is at least not the only source of the relevant readings.[6]

3. Reverse proportionality without context dependent standards

Bresnan (1973) proposed that *many* and *few* function in the same way as gradable predicates. This proposal suggests itself for *few*, which combines with degree morphology in the characteristic way, in particular forming comparative and superlative forms *few+er* and *few+est*. Bresnan extends this type of analysis to *many* by analyzing *more* and *most* as *many+er* and *many+est*. Hackl (2000) further motivated this proposal by providing compelling semantic arguments that support decomposition.[7] In this section, we explore some of the consequences of this point of view, first reviewing a somewhat standard proposal for how to treat gradable adjectives before turning our attention back to cardinal and proportional interpretations of *many* and *few*, in particular interpretations that do not involve a comparison to some kind of standard.

In one prominent analysis of gradable adjectives (see Cresswell, 1976 and von Stechow, 1984, among others), gradable predicates—the elements which most commonly combine with comparative and superlative morphemes—are analyzed using measurements and degrees. For example, gradable adjectives like *tall* can be interpreted as comparing a measurement of height to a degree of some sort, e.g., $[\![\mathit{tall}]\!] = \lambda d.\, \lambda x.\ \mu_{\mathrm{ht}}(x) \geqslant d$, where μ_{ht} maps individuals to the degree of their height. The use of such predicates in constructions like *John is six feet tall* is rather straightforward ($[\![\mathit{John\ is\ six\ feet\ tall}]\!] = \mu_{\mathrm{ht}}([\![\mathit{John}]\!]) \geqslant [\![\mathit{six\ feet}]\!]$). However, the analysis of sentences without an overt degree argument requires a phonologically null operator, often called *POS* (see von Stechow, 1984 and Kennedy, 1999, among others), which takes an

as Westerstahl notes in his work with respect to context sets (Westerståhl, 1985a), it seems to be a general property of language that contextually sensitive variables can receive distinct values for different DPs within the same sentence.

[5] There is some motivation in the literature to resist, in particular, having a reverse proportional lexical entry. For example, unlike the forward proportional lexical entry, a reverse proportional entry would not be *conservative* in the sense of van Benthem (1984). See the discussion in Westerståhl (1985b).

[6] Westerståhl (1985b) had initially detected reverse proportionality in the now famous example *Many Scandinavians have won the Nobel prize in literature*. However, subsequent authors argued that this sentence does not actually allow for the reverse proportional truth conditions of the sort derived by the lexical entry in (5a) (Cohen, 2001, Romero, 2015, 2016). Romero (2015, 2016) argues that the actual interpretation of Westerståhl's example crucially requires reference to the setting of the context dependent standard, which is to be calculated with reference to focus values in the sense of Rooth (1985). We are inclined to agree with Romero's assessment, which is compatible with the conclusions we draw in this paper. Again, it seems very plausible to us that the setting of a contextual standard can yield reverse proportionality or similar effects. What we deny is that standard setting is the only source of reverse proportionality.

[7] Some of the more compelling evidence that Hackl (2000) presents are instances of *split scope*. There are certain sentences that have a reading that is only compatible with truth conditions where the comparative morpheme scopes above an intensional operator while cardinal measurement function scopes below. For example, the sentence *A professor is required to write fewer than two books in order to get tenure* can be true in a context where a professor is only required to write at least one book to get tenure, although the professor is allowed to write more than one.

abstracted degree predicate as an argument. The *POS* operator compares the maximal value of the degree predicate to a contextually set standard. For example, let's suppose that the sentence in (8) has an LF structure like the one in (8a), where *POS* has a meaning similar to the one represented in (8b), where STND is a contextually set standard. With this kind of structure, (8) would have the truth conditions in (8c).

(8) John is tall.
  a. [$POS\ \lambda d$ John is d tall]
  b. $[\![POS]\!] = \lambda D.\ \text{MAX}(D) > \text{STND}$
  c. $\text{MAX}(\{d : \mu_{\text{ht}}([\![John]\!]) \geqslant d\}) > \text{STND} \;\Leftrightarrow\; \mu_{\text{ht}}([\![John]\!]) > \text{STND}$

Critically, the contextually set standard is not an integral part of the semantics of the degree expression itself.[8] Not only is it absent when explicit measurement phrases are used (as with *six feet* in the example above), but it is also absent in comparative constructions. Although the details are not important for our purposes, for concreteness we will sketch a standard view on which the comparative morpheme *-er* denotes a function like (9), taking two degree properties as arguments, one obtained by abstraction in the *than*-clause and the other from the main clause after covert movement of the degree phrase formed by *-er* and the *than*-clause.[9]

(9) $[\![\textit{-er}]\!] = \lambda D_2.\lambda D_1.\ \text{MAX}(D_1) > \text{MAX}(D_2)$

The argument D_2 and D_1 will be furnished by the *than*-clause and the main clause, respectively. To illustrate, a sentence like (10) would have an LF structure similar to the one in (10a), resulting in truth conditions like those represented in (10b).

(10) Mary is taller than Bill is.
  a. $[_{\text{DEGP}}$ -er λd than Bill is d tall] $\lambda d[_{\text{S}}$ Mary is d tall]
  b. $\text{MAX}(\{d : \mu_{\text{ht}}([\![Mary]\!]) \geqslant d\}) > \text{MAX}(\{d : \mu_{\text{ht}}([\![Bill]\!]) \geqslant d\})$

Such truth conditions compare two degrees that are explicitly determined by two clausal arguments, hence they do not make reference to a contextually set standard of comparison.

On this approach, the analysis of *many* and *few* as gradable expressions requires a revision of the lexical entries for *many* and *few* that separates the introduction of a contextually determined standard from the degree expression. Specifically, following Romero (2015), instead of the lexical entries for *many* in (3a) and (4a), we could now have those in (11).

(11) a. $[\![many_1]\!] = \lambda \text{d}.\lambda \text{X}.\lambda \text{Y}.\ |\text{X} \cap \text{Y}| \geqslant \text{d}$
  b. $[\![many_2]\!] = \lambda \text{d}.\lambda \text{X}.\lambda \text{Y}.\ |\text{X} \cap \text{Y}|/|\text{X}| \geqslant \text{d}$

[8] For the sake of simplicity, we ignore the issue of vagueness in terms of setting a value for the standard. For an adequate discussion of vagueness with respect to a standard, see the discussions in Kennedy (2007), Klein (1980), Kamp (1975) and references therein.

[9] As argued by Heim (2000), there are two main facts that support a movement analysis of degree phrases headed by the comparative morpheme. One is that such movement can account for scope ambiguities with intensional operators. For example, there is a reading of *Mary read 5 pages and John is required to to read exactly 2 more pages than that*, which means that the number of pages that John is minimally required to read is exactly two pages more than what Mary read. The other main argument stems from Antecedent Contained Deletion with comparatives (see also Bresnan, 1973, among others). For example, ACD is acceptable in sentences like *John was climbing taller buildings than Mary was*. However, it is unacceptable (or at least strained) in sentences like *John was climbing buildings that Mary was*. Movement of the Degree Phrase [-er than Mary was] out of the VP would create the right environment for VP ellipsis.

Hackl (2000) called these types of meanings *parameterized determiners*. Note that for the sake of simplicity, we will limit our discussion here to *many*, but similar interpretations can be given for *few*.[10] Just like adjectives, these lexical entries compare a measurement (of cardinality or proportion) to a degree. In order to introduce some kind of contextually determined standard, the *POS* operator would need to be introduced. For example, the sentence in (12) has a cardinal interpretation as represented in (12a) and a forward proportional interpretation as represented in (12b).

(12) Many students cheated.
  a. for a contextually determined cardinality STND,
  $[\![POS\ \lambda d.\ d\ many_1\ students\ cheated]\!] \Leftrightarrow$
  $\text{MAX}(\{d : |[\![students]\!] \cap [\![cheated]\!]| \geqslant d\}) > \text{STND} \Leftrightarrow$
  $|[\![students]\!] \cap [\![cheated]\!]| > \text{STND}$
  b. for a contextually determined proportion STND,
  $[\![POS\ \lambda d.\ d\ many_2\ students\ cheated]\!] \Leftrightarrow$
  $\text{MAX}(\{d : |[\![students]\!] \cap [\![cheated]\!]|/|[\![students]\!]| \geqslant d\}) > \text{STND} \Leftrightarrow$
  $|[\![students]\!] \cap [\![cheated]\!]|/|[\![students]\!]| > \text{STND}$

As with regular gradable predicates like *tall*, it is predicted that reference to a contextually determined standard should be absent in comparative constructions. Thus, comparative constructions provide a natural testing ground for whether reverse proportional readings (and proportional readings in general for that matter) are always derived by manipulating a contextual standard.

With this in mind, consider the example in (13), where the positive form of *few* in Herburger's (1997) classic example of a reverse proportional meaning (see (2) above) is replaced by the comparative form of *many*, accompanied by a *than*-phrase, with contrasting phrases *our program* and *yours*.

(13) More cooks applied to our program than to yours.

The sentence in (13) can be read as comparing two ratios, viz. the ratio of applicants to our program that are cooks relative to the total number of applicants to our program and the ratio of applicants to your program that are cooks relative to the total number of applicants to your program, stating that the former ratio is greater. Such a comparison can explain why (13) can be judged as true on the basis of no information about the sets of cooks and applicants to the two programs other than that cooks represent a greater proportion of the applicants to our program, say 20%, compared to the proportion of the applicants to yours, say 10%. (Thus, given what is known, the cardinal and forward proportional interpretation might not be true.) If we let X be the set of cooks, and Y1 and Y2 be the sets of applicants to our program and to your program, respectively, we can state the truth conditions of (13) as in (14).

(14) $|\text{X} \cap \text{Y1}|/|\text{Y1}| > |\text{X} \cap \text{Y2}|/|\text{Y2}|$

[10] The difference between *many* and *few* is akin to the difference between gradable antonyms like *short* and *tall*. Kennedy (1999), based off of a degree ontology introduced by von Stechow (1984), suggests that the difference between antonymous degrees is how they extend: positive degrees extend from zero to a measurement whereas negative degrees extend from a measurement to infinity. Such a solution can be adopted here for *few*. The details would closely follow Kennedy's analysis of the difference between *tall* and *short*.

Thus, (13) allows for a reading that is reverse proportional in the same sense as the relevant reading of (2) described by Herburger (1997), that is, a reading where both the main clause and the comparative phrase make reference to the ratio of the members of the set given by the intersection of the noun phrase and the scope to the members of the set given by the scope alone.

We postpone until the next section the question how exactly these truth conditions arise. What is clear enough, however, is that in the absence of a contextually determined standard, reverse proportionality in (13) shows that reverse proportional readings are not after all dependent on the presence of a contextually determined standard, and therefore are not in general a symptom of the malleability of such a standard, contra the proposals in a whole branch of work on reverse proportionality (Büring, 1996; de Hoop and Solà, 1996; Romero, 2015, 2016; Solt, 2009).[11] In drawing this conclusion, we are in fact stepping in the footprints of Partee (1989), who presented data much like (13). In concluding remarks, Partee presents comparative data that include the example in (15), providing the comments quoted below.

(15) There are more illiterate people in small rural towns than in large cities.

> "Such sentences are potentially valuable sources of data, since comparatives generally remove the ambiguity of vague predicates, and clear truth-conditional differences can then show up between cardinal and proportional readings. However, I think that judgments about the range of possible readings for [such] sentences [...] show a surprising range of possibilities, including a non-CN-based proportional reading for [(15)]." (Partee, 1989: p. 400)

We take it that Partee employs *non-CN-based proportional reading* to refer to the reverse proportional reading discussed above. Indeed, it seems clear that (15) can be judged true on the basis of no other information than the assumption that small towns have a larger proportion of illiterate inhabitants than large cities, in analogy to what we have described for (13).

As is clear from the first sentence in the passage quoted above, Partee also hinted at the very same conclusion regarding reverse proportionality that we have drawn on the basis of (13). Given Hackl's (2000) semantic arguments for the analysis of *many* as a gradable predicate and for decomposition of *more*, bolstering Bresnan's (1973) earlier syntactic arguments, this conclusion in fact looks even more unavoidable now than it did at the time of Partee's writing.

Comparatives are not the only type of degree construction that this conclusion can be based on.

[11] Maribel Romero (p.c.) alerts us to the possibility that the range of interpretations that comparatives are known to participate in could introduce a confound for our argument about the source of reverse proportionality. Indeed, the finding that reverse proportionality is attested in comparatives does not by itself constitute compelling evidence for this conclusion. Bartsch and Vennemann (1972) and Kennedy (1999) draw attention to so-called comparatives of deviation, such as *Frances is more reticent than Hilary is long-winded* (from Kennedy, 1999). These authors argue that such comparatives do make reference to a standard of comparison, and possibly a different standard in the main clause and the *than*-clause. One could accordingly speculate that the reverse proportional reading of (13) is available in virtue of that sentence being interpretable as a comparative of deviation. However, we do not see any independent support for this speculation. In fact, it is inconsistent with our characterization of the truth conditions of (13). Further support for our interpretation of (13) comes from additional observations that we will introduce shortly, in (16) below. Looking beyond comparatives, these observations suggest that the availability of reverse proportionality is never eliminated by removing the dependency on a contextually determined standard of comparison.

Reference to contextually determined standards is also known to be removed in, for example, degree questions, equatives, or cases with demonstrative *that* used as a measure phrase. In such constructions, too, reverse proportional readings can be detected, as the examples in (16) serve to illustrate.

(16) a. Julia found out how many cooks applied.
b. That many cooks had never applied before.
c. Twice as many cooks applied last year.

We take it, if this year, 10% of the applicants were cooks, (16a) could be judged as true in virtue of Julia having found out that that was the case, without implying that Julia found out about any other cardinalities or proportions, including the absolute number of applicant cooks; similarly, (16b) can be true in virtue of the mere fact that in previous years the proportion of cooks among the applicants always remained below 10%, independently of any other cardinalities or proportions; and (16c) can be understood as conveying that last year 20% of the applicants were cooks, again without supporting inferences about other cardinalities or proportions.

To reiterate, we conclude from such data that there exists a source of reverse proportionality (and perhaps proportionality in general) other than contextually determined standards of comparison. We have no reason for doubting that reverse proportionality can in principle be due to the setting of the standard. But we have argued, following Partee (1989), that such standard setting is insufficient to capture all instances of reverse proportionality.

4. Non-standard based sources of reverse proportionality

The question that remains is how to properly analyze reverse proportionality in cases like (13). Below we briefly map out the range of answers emerging from the literature. We then present novel data suggesting that these answers, too, are insufficiently general. Extending arguments presented in Bale and Barner (2009), Wellwood (2014) and Solt (2018), we suggest that this new data demonstrates that reverse proportional readings arise because the measure function underlying the meanings of *many* and *few* is underspecified in terms of its dimension of measurement.

4.1. Lexical and syntactic argument switching

Analyzing *many* and *few* as gradable expressions, and applying the analysis of comparatives outlined above, we are led to assign to (13) a logical form like (17).

(17) [-er λd. than [[d many] cooks] [applied to your program]] λd.[$_S$ [[d many] cooks] [applied to our program]]

Consider now the lexical entry for *many* in (18), which adapts Westerståhl's (1985b) reverse proportional entry proposed in (5a) to the assumed degree based semantics, in parallel to the entries for cardinal and forward proportional entries in (11). Applied to the structure in (17), this entry delivers the intended truth conditions in (18), truth conditions equivalent to those formulated in (14).

(18) $[\![many_3]\!] = \lambda \mathrm{d}. \lambda \mathrm{X}. \lambda \mathrm{Y}.\ |\mathrm{X} \cap \mathrm{Y}|/|\mathrm{Y}| \geqslant \mathrm{d}$

(19) $\text{MAX}(\{d : |[\![\textit{cooks}]\!] \cap [\![\textit{applied to our program}]\!]|/|[\![\textit{applied to our program}]\!]| \geqslant d\}) >$
$\text{MAX}(\{d : |[\![\textit{cooks}]\!] \cap [\![\textit{applied to your program}]\!]|/|[\![\textit{applied to your program}]\!]| \geqslant d\})$

So, while reverse proportional readings in comparatives are beyond the scope of the standard-based approach, their existence is correctly predicted on a lexical analysis, where *many* and *few* are gradable expressions with reverse proportional lexical entries.

That said, the literature also offers a second non-standard based route to reverse proportional readings that is compatible with the existence of such readings in comparatives and other standard-fixing constructions. This approach, pursued in Herburger (1997) and Greer (2014), rejects the proliferation of lexical entries and, instead, locates the added complexity in the syntax-semantics interface. To understand this strategy better, note that the forward proportional entry for *many* in (11b) above can be mapped to the reverse proportional entry in (18) simply by switching the order of two degree property arguments. Herburger (1997) and Greer (2014) argue that rather than having two lexical entries, this switch of the arguments can be accomplished by syntax, or at least focus marking at the syntactic level. We will refrain here from reviewing these accounts in detail—let's call them the *syntactic mapping* analyses. The point we wish to make for the present purposes, is that the syntactic mapping analyses of reverse proportionality are like the lexical ambiguity analyses in that they do not rely on the presence of a contextually determined standard of comparison. Therefore, such analyses, too, are not challenged by reverse proportionality in comparatives and other standard-fixing constructions.

However, supplementing our primary argument about the standard based-approach, we will now argue that, just like the standard-based approach, the syntactic mapping and lexical ambiguity analyses are insufficient to capture the full range of reverse proportional interpretations. The next subsection is dedicated to making this point.

4.2. Contextual proportionality

The example sentences in (20) permit interpretations that are similar to the reverse proportional readings that we have been discussing.

(20) a. There are more boats on Lake Ontario than on Lake Superior.
b. There are more knots in the blue rope than in the red one.
c. Your manuscript has more typos than my manuscript.

Sentence (20a) can be read as comparing the number of boats on Lake Ontario and Lake Superior in proportion to their surface areas. With the surface area of Lake Superior being about four times that of Lake Ontario, (20a) can be true in a scenario where there are, for example, exactly 1000 boats on each lake. Similarly, (20b) can be true in a scenario where, for example, each of the two ropes has exactly 20 knots in it, but where the red rope is, say, three times longer than the blue one; and (20c) can be true in a scenario where there are, for example, 100 typos in each of the two manuscripts, but where the word count of my manuscript is, say, ten times the word count of yours.

In these readings, then, it is not cardinalities that are being compared. Instead, the sentences in (20) appear to allow for truth conditions of the form (21) below. In (20a), X is the set of boats, X∩Y1 and X∩Y2 are the sets of boats on Lake Ontario and on Lake Superior, and m1 and m2 are the surface areas of the two lakes; in (20b), X is the set knots, $X \cap Y1$ and $X \cap Y2$ are the sets of knots in the blue rope and in the red rope, and m1 and m2 are the lengths of the two ropes; and in (20c), X is the set of typos, $X \cap Y1$ and $X \cap Y2$ are the sets of typos in your manuscript and my manuscript, and m1 and m2 are the word counts of the two manuscripts.

(21) $|X \cap Y1|/m1 > |X \cap Y2|/m2$

Comparison of the truth conditions in (21) with those in (14) above reveals that the relevant readings of the sentences in (20) differ minimally from canonical reverse proportional readings. In both types of cases, the numerators of the fractions on the two sides of the inequality are given by parallel syntactic constituents. The only differences concern the denominators of the two fractions. In canonical reverse proportional readings of comparative sentences like (13), the denominators are the cardinalities of the sets determined by the denotation of the scope of *many* in the main clause and the *than*-phrase. In contrast, in the cases in (20), the denominators are certain measurements associated with the denotations of contrasting expressions within the scope of *many*.

The crucial observation is that these measurements are not referred to in the conventional meaning of the syntactic environment in which *many* appears. That is, we take it that there are no constituents in (20a) that refer to a lake's surface area, just like there are no constituents in (20b) and (20c) that refer to a rope's length or a manuscript's word count. We conclude, therefore, that the proportions referred to in the meanings of proportional interpretations are not always fixed by semantic content. We will therefore refer to these readings as *contextually proportional*.[12]

The discovery of contextual proportionality leads us to the lexical entry for *many* in (22). This entry again follows Hackl (2000) in positing that the denotation of *many* takes a degree argument. The interpretation refers to a fraction whose numerator is formed by the cardinality of the intersection of the two set arguments X and Y. The denominator of this fraction is given by the free meta-language variable m, a measurement whose content is underspecified in the sense of not being fixed by conventional meaning. A similar meaning can be given for *few* but we will forego the details here.[13]

(22) Where m is a contextually determined denominator,
$[\![many]\!] = \lambda d.\, \lambda X.\, \lambda Y.\ |X \cap Y|/m \geqslant d$

We can capture the relevant readings of (20) by allowing for m to be set to any value that is salient in the context of an utterance. We take it that in (20), the mention of the lakes, ropes, and manuscripts raises the salience of the relevant surface areas, lengths, and page counts respectively, and hence that m can take on the values specified above for m1 and m2, capturing the readings in question.

[12]Expectedly, contextual proportionality is not limited to comparatives. For example, in parallel to example (16c) above, *There are twice as many boats on Lake Ontario as there are on Lake Superior* can be read as conveying that the proportion of number of boats on Lake Ontario to the surface area of Lake Ontario is two times the proportion of number of boats on Lake Superior to the surface area of Lake Superior.

[13]As noted earlier, an interpretation for *few* can be given that is basically the same as the entry for *many*, modulo the semantics of gradable antonymy. Such a semantics could involve reversing the ordering of the degrees either by reversing the comparative relation (e.g., $[\![few]\!] = \lambda d.\, \lambda X.\, \lambda Y.\ |X \cap Y|/m < d$) or by interpreting degrees as intervals (as in Kennedy, 1999).

The lexical entry in (22) delivers ordinary reverse proportional readings of examples like (2) or (13) as a special case, viz. the case where m is set to the cardinality of the set determined by the scope of *many*, that is where in (22), m is set to $|Y|$. In fact, it is apparent that the entry is general enough to accommodate all of the readings described above. The forward proportional that Partee (1989) detected in examples like (1b) obtains when m is set to $|X|$ and the cardinal reading attested in (1a), when m is set to 1.

These observations suggest that the seemingly obvious analysis of contextual proportionality put forth here is general enough to cover the full range of readings that *many* is perceived to participate in. We propose, therefore, that the existence of contextual proportionality places the burden of proof on those who wish to argue, following Westerståhl (1985b), Herburger (1997), and Greer (2014), that canonical reverse proportional readings are a matter of conventional meaning fixed by either lexical meaning of *many* or *few* alone (Westerståhl, 1985b) or by the interaction of lexical meaning with the mapping of syntactic material to the argument positions of *many* or *few* (Herburger, 1997; Greer, 2014). In fact, more generally, we take contextual proportionality to present a new challenge to those wishing to argue, following Partee (1989), that *many* or *few* are lexically ambiguous.

While we seem to be first to discuss contextual proportionality, the relevant interpretations of the cases in (20) are reminiscent of certain familiar data points, discussed in Cresswell (1976) and Bale and Barner (2009), regarding the interpretation of *much* plus mass nouns. Contextualizing our findings reported in this subsection, we will conclude in the next and final subsection by identifying this connection and its possible consequences.

4.3. Measurements and proportionality with mass nouns

There is an interesting parallel between the context sensitivity of *many*, as described above, and the behaviour of mass nouns in comparative constructions. We will briefly summarize the facts with respect to mass nouns before proposing a general interpretation of *many/much* that integrates the count and mass interpretations into one *parameterized determiner*. It should be noted that our point here is rather modest, namely that it is possible to account for the patterns in comparatives by having a single lexical entry for *much/many* with a context sensitive measurement function. This possibility simplifies our lexical entries even further and, all else being equal, should be preferred to a theory that has multiple lexical entries to account for the different readings of comparative sentences.

As thoroughly discussed in Cresswell (1976) and Bale and Barner (2009), comparatives that modify mass nouns involve truth conditions that specify fundamentally different types of measurements. For example, to judge the comparison in (23a), one normally needs to know the volume of water in the two buckets. In contrast, to adequately judge the comparisons in (23b) and (23c), one needs to know the length of the two strings and the number of items of furniture in the two rooms, respectively.

(23) a. John's bucket has more water than Mary's. (comparison of volume)
b. John has more string in his desk than Mary. (comparison of length)
c. John's bedroom has more furniture than Mary's. (comparison of number)

If we assume that *more* in these sentences decomposes into *much+er* (on analogy to the analysis of *many+er* as discussed in Bresnan, 1973), we would need to hypothesize a meaning for *much* that has a context sensitive measure function.

(24) $[\![\textit{much}]\!] = \lambda d.\, \lambda X.\, \lambda Y.\, \mu(X \cap Y) \geqslant d$,
where μ can yield a measure of length, weight, volume, number etc.[14]

Note that the variability in the measurement function is not completely determined by the nominal complement. As noted by Cresswell (1976) and Bale and Barner (2009), one and the same nominal complement can induce truth conditions that rely on different types of measures. For example, in contexts where weight contrasts with volume, the sentence in (23a) can be judged as both true and false, depending on which type of measure is contextually emphasized. Similarly, consider the sentences in (25).

(25) a. This ring has more gold in it than that necklace.
b. This bottle of wine has more alcohol in it than that bottle.

If we assume that the ring is small whereas the necklace is rather large and we further assume that the ring is slightly closer to being "pure gold", the sentence in (25a) can be judged as both true and false. It can be true if the relevant measure is taken to be the proportion of gold in the ring versus the proportion of gold in the necklace, but it can be false if the relevant measure is taken to be the weight/volume of gold in the ring versus the weight/volume of gold in the necklace.

A similar observation can be made about (25b). If we assume that the first bottle only has a litre of wine but has a higher alcohol percentage, whereas the second has two litres of wine but a slightly lower alcohol percentage, then the sentence in (25b) can be both true and false. It can be true if the relevant measure is taken to be the proportion of alcohol in the wine, but it can be false if the relevant measure is taken to be the overall weight/volume of alcohol in the wine.

Hence, the measure function can take on different values with respect to the same nominal complement much like the variety of readings of *many* demonstrated in the previous subsection. This naturally leads to the question of whether *much* and *many* are allomorphs of a single lexical entry, as independently argued for by Chierchia (1998) and Wellwood (2014) for morphosyntactic reasons. This could be represented as in (26).

(26) $[\![\textit{much/many}]\!] = \lambda d.\, \lambda X.\, \lambda Y.\, \mu(X \cap Y) \geqslant d$,

where μ has a contextually set value (e.g., one of μ_{WT}, μ_{VOL}, μ_{LENGTH}, $\mu_{\#}$, $\mu_{\frac{\text{VOL}}{\text{VOL-OF-X}}}$, $\mu_{\frac{\text{VOL}}{\text{VOL-OF-Y}}}$, $\mu_{\frac{\#}{\text{\#-OF-X}}}$, $\mu_{\frac{\#}{\text{\#-OF-Y}}}$, $\mu_{\frac{\#}{\text{LENGTH-OF-ROPE}}}$, $\mu_{\frac{\#}{\text{AREA-OF-LAKE}}}$, etc.).

This analysis is very much in the spirit of a recent proposal by Solt (2018), who also argues that the ambiguity between cardinal and proportional readings is best understood as rooted in context dependency as it relates to an underspecified measure function. However, Solt motivates her analysis with rather different data (e.g., differentials and partitive constructions). It is important to note that Solt's analysis does not capture the observations we have focused on here. In her original analysis, the range of possible values available for the measure functions is restricted in a way that prevents it from capturing either reverse proportionality (contextual

[14]Although μ in (24) applies to a set (the intersection of X and Y), it ultimately can be understood as a measurement of a plurality, namely the measurement of the supremum of the intersection. See Bale and Barner (2009) for details.

or not) or contextual proportionality (reverse or not). The data we have presented, then, support the conclusion that, while Solt's proposal goes in the right direction, the value of the measure function is even less regulated by grammar, and more shapable by context at large, than Solt envisioned.

If something like (26) is on the right track, then the main task that we, as researchers, face is to explain why certain types of measurements are unavailable in certain contexts. For example, why are measurements of temperature never available? Why is volume available when measuring water but not when measuring boats? Why is length available when measuring rope but not when measuring people?

Some of these questions have already been answered in Schwarzschild (2002), where it was noted that such measure functions must be monotonic with respect to the subgroup/subaggregate relation inherent in the nominal complement (which, for example, rules out measurements of temperature). Wellwood (2014) attempts to develop a stronger constraint than monotonicity, one that maintains that the relevant measure function is invariant under all automorphisms on the denotation of the nominal complement. Such a constraint would explain why count nouns cannot be measured in terms of weight or volume, but yet permit measurements of number and proportions. For now, we will simply note that this is an active and interesting area of research. We think that the proportional data discussed above will play a critical role in determining whether a univocal meaning for *much/many* is plausible and, if so, what type of constraints are needed to limit the number of contextually available measure functions.

5. Conclusion

We have argued that, while the standard-based approach to reverse proportionality with *many* and *few* is motivated by considerations of theoretical parsimony, the finding that reverse proportionality is attested in standard-fixing constructions such as comparatives shows this approach to be insufficient. Based on the discovery of contextual proportionality, we have moreover argued that proportionality in general is due to the fact that sentences with *many* and *few* do not semantically fix the measure that determines what value is being compared to the standard of comparison. Taking into account a broader range of data, then, considerations of theoretical parsimony suggest that the underspecification of this measure is the key to the meaning of *many* and *few*, and raise the question whether anything more needs to be said about *many* and *few* to capture the readings that have been posited in the literature.

We of course do not pretend to have offered a conclusive answer to this question. One prominent issue that remains to be investigated consists in grammatical constraints on cardinal and proportional readings that have been described in the literature. For example, Partee (1989) reports that cardinal readings are excluded when *many* and *few* appear in partitives or as subjects of individual-level predicates in the sense of Carlson (1977). Also, Büring (1996), Cohen (2001), Herburger (1997), and Romero (2015, 2016) all discuss the interaction of certain readings with focus structure. On the approach we have proposed, any such constraints would have to be interpreted constraints on the setting of the underspecified measure. We will leave an assessment of the prospects of such a reinterpretation to future work.

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The role of the particle *-oo* in *wh*-exclamatives in Telugu and Kannada[1]

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Abstract. A non-degree approach like d'Avis (2002) doesn't work for degree readings of *wh*-exclamatives since it is based on a Groenendijk and Stokhof (1984) denotation of questions. The Widening account of Zannutini and Portner (2003) doesn't work for individual/event readings of *wh*-exclamatives because of a Karttunen (1977) denotation of questions. Degree denotation approaches to *wh*-exclamatives can't explain the variability either. We propose a solution such that the widening account works if we start with Hamblin alternatives. Evidence for the widening mechanism comes from *wh*-exclamatives in Telugu/Kannada –the particle *-oo* which imposes a *join* requirement on the semantic content of its immediate context (Szabolcsi 2015). We propose that the semantic/pragmatic mechanism of *wh*-exclamatives involves the following three steps –Generating alternatives: wh-focus or other focus mechanisms; Scale to order the alternatives: lexical degree scale/degree morpheme or a likelihood scale; Widening & Dynamic update: Widening of domain from ES to D_2 and Add $\{p\}$ to FC_{spkr}.

Keywords: degrees, widening, wh-exclamative, Dravidian.

1. Introduction

The problem with the theoretical approaches in the analysis of *wh*-exclamatives is the bifurcation in their applicability. A non-degree approach like d'Avis (2002), based on a Groenendijk and Stokhof (1984) denotation of questions, doesn't work for degree readings of *wh*-exclamatives. On the other hand, the widening account of Zannutini and Portner (2003), based on a Karttunen (1977) denotation of questions, doesn't work for individual/event readings of *wh*-exclamatives. The degree denotation approaches to *wh*-exclamatives, like Castroviejo (2006) and Rett (2011), can't explain these readings either.

In this paper we propose an analysis that works for both degree readings and individual/event readings, where we essentially show that the widening account works if we start with Hamblin alternatives. Further, we find evidence for the widening mechanism from *wh*-exclamatives in Telugu/Kannada –the particle *-oo* which imposes a *join* requirement on the semantic content of its immediate context (Szabolcsi 2015). The degree vs. individual/event reading difference is a property of the scale used to order the alternatives –degree or likelihood. More cross-linguistic variation –surprise vs. non-surprise, factivity vs. lack of factivity, fall out of the mechanism of widening and how that updates the discourse structure —choices of Expectation Set; and adding to Common Ground or not.

2. Degrees vs. Propositions

2.1. Grimshaw's s-selection

Grimshaw (1979), based on Elliot (1971, 1974), introduces semantic clause types with the features proposition [P], question [Q], and exclamative [E] to explain why surprise-predicates but not rogative-predicates embed certain types of wh-clauses (data from Abels 2004):

[1]We would like to thank Ankana Saha, Utpal Lahiri, and the audience of SuB 23 for comments and discussion. All errors are our own.

Proceedings of Sinn und Bedeutung 23, vol. 1, pp. 109–126. Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès).

(1) a. Ian {knows / is surprised / *is wondering} that Pam likes parties.
b. Ian {knows / *is surprised / is wondering} whether Pam likes parties.
c. Ian { knows / is surprised / is wondering} who likes parties.
d. Ian { knows / is surprised / *is wondering} what a great success the party was.
e. Ian {knows / is surprised / *is wondering} how very wide the Ganges is.

(2) a. know [_______ Š], [_______ { P, Q, E }]
b. is surprised [_______ Š], [_______ { P, E }]
c. is wondering [_______ Š], [_______ { Q }]

In her system (1d) and (1e) are unambiguously [E] and (1c) is ambiguous between [E] and [Q]. The necessity of the clausal type feature, [E] in particular, has been questioned by Huddleston (1993), Lahiri (2000), d'Avis (2001, 2002); Zanuttini and Portner (2000, 2003), Abels (2004), among others. One leading counter-argument is that (1c) is not ambiguous between [E] and [Q], it is unambiguously [Q]. As Lahiri (2000) notes "While there is no doubt about the existence of a class of embedded clauses that one may call embedded exclamatives, the issue is whether all *wh*-clause complements of these predicates are embedded exclamatives." d'Avis (2001, 2002), Abels (2004), and Sæbø(2010) propose that (1d) and (1e) seem to be [E] or 'exclamative-only' because of independent semantic reasons, though each gives their own proposals for why it is so. Sæbø (2010) notes that "there are indeed different readings of *wh*-clauses involved, but these nuances do not concern the meaning type common to exclamatives and interrogatives: a function assigning to any world a true proposition."

2.2. ⟦*wh*-exclamative⟧ = ⟦*wh*-Q⟧ Gutierrez-Rexach (1996, 2008)

Based on Groenendijk and Stokhof's (1984) notion of strong exhaustivity, Gutierrez-Rexach (1996, 2008) posits the exclamative operator EXC over propositions, (3).

(3) Let *a* be an agent (the speaker), *w* a world (typically the actual world), *p* a proposition, and P ∈ EMOT (the set of emotive properties). Then,
$\text{EXC} =_{df} \lambda a_i \lambda w_s \lambda p_{\langle s,t\rangle} \exists P_{\langle s,\langle\langle s,t\rangle,\langle e,t\rangle\rangle\rangle}[\text{P(w)(p)(a)}]$

EXC takes the unique true proposition that interrogatives denote, in a Groenendijk and Stokhof (1984) fashion of interpretation, (4):

(4) How tall is John?
What is the maximal degree d such that John is dtall?
$\iota \text{p} \, \exists \text{d} \, [\text{p(w)} \,\&\, \text{p} = \lambda \text{w'}[\text{d} = \textsc{max}(\lambda \text{d'}[\text{tall(w')(j,d')}])]]$

(5) ¡Qué/lo alto que es Juan!
what/the tall that is Juan
'How tall Juan is!'

The major drawback of this analysis is that the workings of the EXC operator in an exclamative like (5) are opaque. In a way, it is a black box whose internal workings are unmotivated.

2.3. ⟦*wh*-exclamative⟧ = ⟦*wh*-Q⟧ d'Avis (2002)

d'Avis (2001, 2002) proposes that there is no [E] type. So-called *wh*-exclamatives are of the same semantical type as *wh*-interrogatives (at least for German). The way independent *wh*-

clauses can be used as exclamations in this analysis is that exclamations denote a relation between the speaker and at least two propositions. The first proposition describes the true state of affairs, i.e the speaker knows the strongly exhaustive answer. The second proposition, the *norm-proposition*, is a subset of the complement set of the weakly exhaustive answer that the speaker expected to be true, as illustrated in (6).

(6) a. 'Heinz is amazed at who came.'
b. Heinz knows: answer_2 (who came) and Heinz expected: $\neg$ answer_1 (who came) (here answer_2 is strongly exhaustive & answer_1 is weakly exhaustive)
c. "at least these two propositions are ordered on a scale in a way that the expected proposition is the one that sets the norm, and the true proposition is orderd at a distance that reflects the strength of the deviation from the norm."

d'Avis notes that "existence of a certain state of affairs, evaluation part, derivation of an object of comparison are given by the function of the obligatory exclamative accent as a reflex of the emotional involvement of the speaker. The interrogative meaning of the wh-clause provides the set of propositions that are needed to compute the relevant norm-proposition." The biggest drawback of the d'Avis proposal is that it won't work for degree *wh*-exclamatives like 'How expensive gucchi is!'

2.4. R*widening* & R*factivity*: Zannutini and Portner (2003)

Zannutini and Portner (2003) [ZP] propose two syntactic properties which define the class of exclamatives: exclamatives contain a *wh*-operator–variable structure; and exclamatives contain an abstract morpheme FACT in the CP domain. These contribute the two crucial components of meaning to the denotation: exclamatives denote a set of alternative propositions, a result of the operator–variable structure; and exclamatives are factive, their propositional content is presupposed; the result of the abstract morpheme FACT. The 'use' of exclamatives is analyzed in terms of another fundamental concept, that of WIDENING, which is their sentential force: exclamatives widen the domain of quantification for the *wh* operator. Widening is not in general directly encoded in the syntax; it is, however, derived on the basis of pragmatic reasoning: widening is the only use available to root sentences with the two semantic properties in question, i.e. self-presupposed questions.

$\text{R}_{factivity}$, the syntactic element that represents factivity, introduces a presupposition that the propositional content of the exclamative is true, (7).

(7) For any clause S containing $\text{R}_{factivity}$ in addition to $\text{R}_{widening}$,
every $p \in [\![\text{S}]\!]_{w,D_2,\prec} - [\![\text{S}]\!]_{w,D_1,\prec}$ is presupposed to be true.

$\text{R}_{widening}$, the syntactic element that represents the pragmatic operation of widening, has the semantics of a quantificational operator, (8). An example of widening is given in (9).

(8) For any clause S with $\text{R}_{widening}$, widen initial domain D_1, to new domain, D_2, such that:
a. $[\![\text{S}]\!]_{w,D_2,\prec} - [\![\text{S}]\!]_{w,D_1,\prec} \neq 0$
b. $\forall x \forall y[(x \in \text{D}_1 \& \; y \in (\text{D}_2 - \text{D}_1)) \rightarrow x \prec y]$

(9) a. che roba che l magna! PADUAN
what stuff that he eats
'The things he eats!'

b. $[\![$che roba che l magna!$]\!]_w$ = {p: p is true in w and ∃a [p='he eats a']}

c. $[\![$ che roba che l magna! $]\!]^{D_{1/2}} = \left\{ \begin{array}{l} \left\{ \begin{array}{l} \text{He eats poblanos} \\ \text{He eats jalapeños} \end{array} \right\}^{D_1} \\ \textbf{He eats habaneros} \end{array} \right\}^{D_2}$

ZP also explain *wh*-phrases that only occur in exclamatives, 'E-only' *wh*-phrases, in Paduan, via the extra CP layer in *wh*-exclamatives.

However, the ZP proposal won't work for an exclamative like in (10). The Karttunen denotation (true answers) won't work for determining the set of alternatives, as here there is only one alternative.

(10) a. *Heinz is amazed at who Uma married.*
b. Suppose the alternatives are [Kiran, Bhanu, Ravi] and the True answer is {Ravi}
c. Domain_1 = Uma married Ravi Domain_2 = ???

2.5. $[\![$*wh*-exclamative$]\!]$ = degree denotation

Quite a few analyses of exclamatives propose that they are based on degrees. Of these, only Villalba (2003) and Castroviejo (2006) propose formal accounts which explicitly restrict the interpretations of exclamatives to degree readings. But the accounts of both focus on a particular subtype of exclamative in Catalan, one with explicit degree morphology. Rett (2011) draws on their observations and accounts to make broader claims about exclamatives generally.

2.5.1. Castroviejo (2006) and Villalba (2003)

Villalba (2003) posits a null degree operator, (11), in Catalan *que*-exclamatives, a maximality operator over degrees, following Rullmann (1995), and Gutierrez-Rexach (1996) for Spanish degree neuter constructions. Only *wh*-degree/amount words can make *wh*-exclamatives, and only degree/amount readings are possible.

(11) [$_{CP2}$ DegOp [$_{C2'}$ [$_{CP1}$ FACT [$_{C1'}$ que [$_{IP}$ n'és de car aquest vi]]]]]

Castroviejo (2006, 2008) analyses the semantics and pragmatics of *wh*-exclamatives in Catalan, like in (12), as in (13).

(12) a. Quina pel·lícula **més/tan** entretinguda que vaig veure
what movie more/so entertaining that I saw
'What an entertaining movie I saw!'

(13) a. Fact: ∃x[pel.lícula(x) ∧ TAN(entretinguda(x))(d_i) ∧ veure(s)(x)]
Where:

i. $[[\text{TAN}(d_S)(d_R)]] = 1$ iff $d_S \geq d_R$
ii. $d_S = d_i$
iii. d_i is a degree recovered from context that is high.

b. Contribution: the speaker experiences an attitude towards $\hat{}$TAN(entretinguda(x))(d_i)

But the problem with both approaches is that they won't extend cross-linguistically, because they are too specific to Catalan.

2.5.2. Rett (2011)

Rett (2008, 2011) capitalize on 'Q-only' *wh*-words (*who/when/where*) and propose that *wh*-exclamatives denote degrees, not what *wh*-questions denote –sets of propositions, (14)-(15).

(14) [what$_j$ [[$t_{j_{\langle d \rangle}}$ delicious desserts]$_i$ John baked $t_{i_{\langle x \rangle}}$]]
a. $[\![$John baked $t_{i_{\langle x \rangle}}]\!]$ = baked′(j,x)
b. $[\![t_{j_{\langle d \rangle}}$ delicious desserts$]\!]$ = λx.desserts′(x) $\wedge$ delicious′(x,d)
c. $[\![t_{j_{\langle d \rangle}}$ delicious desserts$]\!]$ (λx$_i$. $[\![$John baked $t_{i_{\langle x \rangle}}]\!]$)
= λx.baked′(j,x) $\wedge$ desserts′(x) $\wedge$ delicious′(x,d)
d. $[\![$what$]\!]$(λd$_j$.$[\![t_{j_{\langle d \rangle}}$ delicious desserts John baked $t_{i_{\langle x \rangle}}]\!]$)
= λdλx.baked′(j,x) $\wedge$ desserts′(x) $\wedge$ delicious′(x,d)
e. $\leadsto_{\exists closure}$ $\lambda d\exists$x[baked′(j,x) $\wedge$ desserts′(x) $\wedge$ delicious′(x,d)

(15) What a song John wrote!
$\lambda d \exists x[song(x) \wedge wrote(j,x) \wedge \mu_\alpha(x) = d]$

Rett models the illocutionary force of exclamations 'E-FORCE', as a function from propositions to speech acts of exclamation. The degrees get converted to propositions along the way, (16).

(16) E-FORCE*(p)*, uttered by s_C, is appropriate in a context C if p is salient and true in w_C. When appropriate, E-FORCE*(p)* counts as an expression that s_C hadn't expected that p.

Rett notes that in degree exclamatives an individual reading is not possible, only a degree-reading is available, (17), using the 'card test'.

(17) *Context*: Drawing the same unremarkable card (six of spades) for a 3^{rd} time:
What a card he drew!

Similarly Rett (2011) observes that an evaluative reading is good, whereas a manner reading is not possible, (18), with *wh*-exclamatives.

(18) *Context*: Ravi writes {complex, elegant, simple, beautiful} sentences.
a. How Ravi writes!
Context: Ravi writes {left-to-right, non-cursive} sentences.
b. # How Ravi writes!

Finally, she notes that unexpected alternatives are also not available, (19), with *wh*-exclamatives.

(19) *Context*: Ravi speaks English and Hindi, which is unexpected, since his parents speak Kannada and Telugu.
a. # What languages Ravi speaks!

Context: Ravi speaks many languages, including exotic ones like Ibibio.
b. What languages Ravi speaks!

2.6. Type1 vs. Type2 *wh*-exclamatives

2.6.1. Type2 *wh*-exclamatives: Nouwen and Chernilovskaya (2015)

Nouwen and Chernilovskaya (2015) [NC] find many languages like Dutch, German, Russian, Hungarian, Italian, and Turkish, with matrix *who/when/where*-exclamatives, (20).

(20) Wie ik gisteren tegenkwam! DUTCH
Who I yesterday came-across
(roughly) 'You wouldn't believe who I met yesterday!'

These *wh*-exclamatives, that they label as Type2 are fine in Rett's card test, devised to test non-degree readings. There seems to be no degree intensification of an implicit or explicit gradable property. NC conclude that these readings are non-scalar. They propose that the degree-scalar *wh*-exclamatives of Rett, referring to scalar properties of the *wh*-referent, that they call Type1 *wh*-exclamatives, target the individual singled out by the *wh*-phrase. Further, they propose that Type2 *wh*-exclamatives are event-scalar, and target the event the *wh*-referent takes part in, rather than the *wh*-referent. They do not offer a formal semantic model of the reported variation.

NC find that Dutch Type1 may be either V-2 or V-final, (21), while Type2 are only V-final, (22). Type1 involve non-standard *wh*-constructions, whereas Type2 are like interrogatives.

(21) a. Wat **maakte** Jan een herrie!
What made Jan a racket
'What a racket Jan made!'

b. Wat Jan een herrie **maakte**!
What Jan a racket made
'What a racket Jan made!'

(22) a. *Wie **zag** ik net!
Who saw I just

b. Wie ik net **zag**!
Who I just saw

NC note that Type1 can be structurally more enriched (articles, etc.) than Type2, (23).

(23) a. Wat een kaarten hij toen (weer) trok! [not good in card-trick context]
what a cards he then again picked

b. Wat hij toen (weer) trok! [good in card-trick context]
what he then again picked

2.6.2. Morpho-Syntax of Type1 vs. Type2 *wh*-exclamatives: Repp (2016)

Repp (2016) finds that in German the V-2 order can only be a Type1 reading. V-2 exclamatives involve a subset of the wh-words – those that can be used in a degree reading, (24), unless there is a degree word like *all* in the clause along with a non-degree *wh*-word like *who*, *where*, etc.

(24) a. Was **war** das für ein Traum!
what was that for a dream
'What a dream that was'
(*like matrix Q*)

b. Was das für ein Traum **war**!
what that for a dream was
'What a dream that was'
(*like embedded Q*)

Repp finds that only the V-final order can host Type2 readings, (25).

(25) a. Wen der eingeladen **hat**!
who.ACC he invited has

b. Wann der gekommen **ist**!
when he come is

2.6.3. Morpho-Syntax of Type1 vs. Type2 *wh*-exclamatives: Lipták (2005)

Lipták (2005) finds that in Hungarian, the inversion order, which is the interrogative order can be either Type1 or Type2, (26), whereas the non-inversion order can only be Type1, (27).

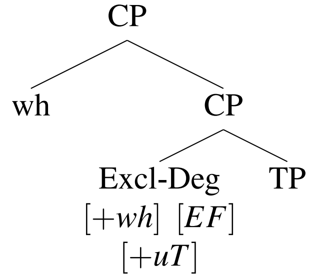
(26) Mennyi könyvet olvastál el!
how.many book.ACC read.2SG PV
'How many books you read!'
(*like wh-Q*)

(27) Mennyi könyvet el-olvastál!
how.many book.ACC PV-read.2SG
'How many books you read!'
(*not like wh-Q*)

2.6.4. Semantics of Type1 vs. Type2 *wh*-exclamatives: Repp (2016)

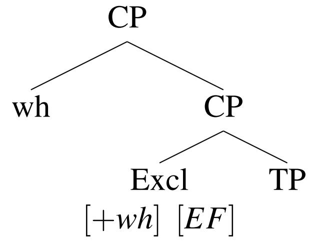
Repp (2016) proposes that in German, V-2 and V-final *wh*-exclamatives differ in the kind of speech act operator they combine with –a degree property taking operator in V-2 *wh*-exclamatives which also triggers verb movement, and an individual or degree property taking operator in V-final *wh*-exclamatives that does not trigger verb movement (28).

(28) a.



$[\![$Excl-degree$]\!] = \lambda D_{\langle d,t\rangle} \exists d$ [speaker finds $\lambda w.D(d)(w)$ surprising]

(to be expressively correct, the speaker must be suprised by the degree to which the property applies) b.



⟦Excl⟧ = $\lambda P_{\langle\tau,t\rangle}\exists x$ [speaker finds $\lambda w.P(x)(w)$ surprising]
$\langle\tau,t\rangle = \langle e,t\rangle$ or $\langle d,t\rangle$
(to be expressively correct, the speaker must be suprised that a property applies to an individual, or by the degree to which the property applies)

Repp (2016) proposes that the degree property taking operator thus composes only with degree property denoting *wh*-words,(29b), (or when a degree property is created via a degree word like *alles*). Individual property denoting *wh*-words, (29a), compose with the V-final operator.

(29) a. ⟦who⟧ = $\lambda Q\lambda x[human(x) \wedge Q(x)]$
b. ⟦what a⟧ = $\lambda Q\lambda d[D(d) \wedge d \succ s]$

3. Telugu/Kannada *wh*-exclamatives

3.1. Telugu/Kannada: degree *wh*-words with Type2 reading

So far, we have seen that a Type1 (degree) *wh*-item cannot get a Type2 (event/individual) reading. But in Telugu/Kannada we have cases where an individual *wh*-item is not only Type1, (30), but the same *wh*-item is also Type2, (31)-(32). The examples given in this paper are from Telugu unless otherwise mentioned.

(30) a. ravi **enta** navveeD-oo!
Ravi how-much laughed-OO
'How much Ravi laughed!'

b. ceTTu **eemi** ettu und-oo!
tree what height be-OO
'How tall the tree is!'

Context: Ravi says he can pick up the exact amount of rice that you ask:

(31) ravi **enta** biyyam leepeeD-oo!
Ravi how-much rice lifted-OO
'How much rice Ravi picked up!'

Context: Ravi picks up the same card (six of spades) from the deck again:

(32) ravi **eemi** card leepeeD-oo!
Ravi what card lifted-OO
'What card Ravi picked!'

Adverbial *wh*-phrases also show a Type1 (evaluative: fast) and a Type2 (manner: backwards) pattern, (33a). The *wh*-item *elaa* is also acceptable (for some speakers at least) as a non-adverbial Type1 or Type 2 *wh*-exclamative, (33b).

(33) a. **elaa/eemi** parigettutaaD-oo!
how/what runs-OO
'How (he) runs!'

b. ravi **elaa** navveeD-oo!
Ravi what laughed-OO
'How much Ravi laughed!'

3.1.1. Telugu/Kannada: Only Type2 *wh*-exclamatives

Telugu/Kannada also have only Type2 *wh*-phrases: those that explicate the cross-linguistically uncommon exclamative construction, ranging over individuals or entities (or what NC call *e(vent)*-level interpretation), (34).

(34) a. bus-loo **evvvar**-ni cuuseen-oo!
bus-in who-ACC saw-OO
(roughly) 'You wouldn't believe who I saw in the bus!'

b. ravi **enduku** vacceeD-oo!
Rav what-for came-OO
(roughly) 'You wouldn't believe what for Ravi came!'

3.1.2. The Telugu/Kannada Type1/2 problem

For Repp, and other degree-approach extensions, Type1 *wh*-items are degree set restrictors. Type1 *wh*-exclamatives denote degree properties and they cannot get a Type2 reading. Type2 *wh*-items are Individual set restrictors, which denote individual properties. They can however combine with a degree morpheme and get a Type1 reading. But how do we explain the Type1 *wh*-items in Telugu/Kannada that can get a Type2 reading? Is type shifting at work? Our answer is that the denotations are invariant (propositions), and another mechanism is responsible for Type1 vs. Type2 interpretation, the scale used to order them, which we elaborate on in the next section.

3.2. The role of -oo in *wh*-exclamatives: to signal Domain Widening

3.2.1. Distribution of *-oo*: Matrix *wh-* clauses

In matrix clauses in both Kannada and Telugu, a plain question interpretation arises only when the particle *-oo* is left out, and the *wh*-clause is unmarked with particles, (35).

(35) enta duuram velleeDu?
how far went
'How far did (he) go?'

The particle *-oo* is good in matrix *wh*-clauses, in both Kannada and Telugu, only when interpreted either as being embedded under *wonder* (36); or as an exclamation (37); depending on the intonation — (?) or (!).

(36) enta duuram velleeD-oo ?
how far went-OO
'I wonder how far (he) went.'

(37) enta duuram velleeD-oo !
how far went-OO
'How far (he) went!'

3.2.2. The wonder reading with *-oo*: Non-Intrusive Questions

The 'wonder' use of *-oo* goes beyond the English *wonder*, (38).

(38) nii peeru eemiT-oo
your name what-OO
'May I know your name please'
'I wonder what your name is'

What *-oo* delivers is a non-canonical meaning, namely, a non-intrusive question, as noted by Farkas (2018) for *oare* interrogatives in Romanian, (39).

(39) oare pe.cine a invitat Rodica?
oare who.Acc has invited Rodica
'Who has Rodica invited, I wonder'

Like in canonical questions, the Speaker raises an issue and thereby signals that he wishes to have it resolved. But unlike canonical questions, the Speaker signals that he does not wish to put the Addressee on the spot for providing the answer.

3.2.3. Testing *-oo*'s non-intrusive contribution

It is infelicitous in contexts where the Addresse is mandated to answer the question, (40).

Doctor to patient
(40) *ivala enni gooliilu tiisukunnaav-oo
today how-many tablets take-OO
'How many tablets did you take today, I wonder.'

It is appropriate in contexts where Addressee competence is presupposed, but Addresse may have reasons to withhold the anwer, (41).

Chef to guest:
(41) miiku ee-kuura naccind-oo
you which-curry like-OO
'Which curry did you like, I wonder.'

It is appropriate as an 'engaging' question, in which Addresse competence assumption is absent, (42).

Host of party to co-host:
(42) enta mandi vastaar-oo
how-many people come-will-OO
'How many people will come, I wonder.'

It is even appropriate in some self-addressed contexts (though not in *I-can't find-the-value* questions), (43).

Exasperated friend to a troublesome friend:
(43) ninnu enduku piliseen-oo
you why called-OO
'Why did I call you, I wonder.'

It is not necessarily addressed to the Hearer, it can express a wish to know the answer, (44).

(44) a. *A movie goer to a friend*:
Speaker: eppuDu avutund-oo
when finish-OO

'When will it finish, I wonder.'

b. Addressee: *nannu enduku aDugutunnaavu?
me why asking
'Why are you asking me?'

But it is not good when the Speaker knows the answer –'obvious anwer' rhetorical questions, (45).

A race car driver at a car rental:

(45) *naaku toolaDam enta baagaa vacc-oo
I.DAT driving how well come-OO
'How well do I know driving, I wonder.'

It is also not good when the addressee is competent and there is no reason for non-cooperation, (46).

To the session chair who is keeping track of time:

(46) *inkaa enta seepu und-oo
still how-much time be-OO
'How much time is still there, I wonder.'

3.2.4. The semantics/pragmatics of non-intrusive *-oo*

Following Farkas (2018), we propose that *-oo* weakens the Addressee compliance effect of canonical questions, to form non-intrusive questions. *-oo* questions widen the range of projected futures, which now include not only ones in which the Addressee resolves the issue just raised, but also a future in which (s)he choses not to, leaving the Addressee more choice, allowing for no Addressee response.

(47) a. Contribution of *-oo* in interrogatives
Add $DC_{Ad,i}$ to ps_o

b. A question is non-intrusive iff the form used to ask it adds the input $DC_{Ad,i}$ to ps_o. As a result, **Addressee compliance no longer requires the Addressee to resolve the issue raised.**

The Addressee therefore can comply with an *-oo* question without resolving the issue, though futures in which he does resolve it would be preferable, since those involve information increase. Following Farkas (2018), we model unmarked polar questions vs. *-oo* marked polar questions as in (48)[2].

(48) a. uma vellind-aa?
Uma went-Q_p
'Did Uma go?'

[2]Here, the Inquisitive Semantics notations used are: CDE = Conventional Discourse Effects, DC = Discourse Commitments, i = input, o = output, Sp = Speaker, Ad = Addresse; ps = projected set, s = state in which Uma went, $\bar{s}$ = complement of s., Table = stack of propositions.

i. Semantics: p = $\{s, \bar{s}\}$
ii. CDE: basic
1. $DC_{o,Sp} = DC_{i,Sp} \bigoplus$ info(p) = s $\cup$ $\bar{s}$ added to $DC_{i,Sp}$
2. $Table_o = Table_i \circ p$ = $\{s, \bar{s}\}$ added to top of Table stack
3. $ps_o = \{DC_{i,Ad} \bigoplus s, DC_{i,Ad} \bigoplus \bar{s}\}$ = each element in *p* added to Addresse commitments, $DC_{i,Ad}$

b. uma vellind-oo leed-oo?
Uma went-OO not-OO
'Did Uma go or not, I wonder.'
i. Semantics: p = $\{s, \bar{s}\}$
ii. CDE: augmented by contribution of *-oo*
1. $DC_{o,Sp} = DC_{i,Sp} \bigoplus$ info(p) = s $\cup$ $\bar{s}$ added to $DC_{i,Sp}$
2. $Table_o = Table_i \circ p$ = $\{s, \bar{s}\}$ added to top of Table stack
3. $ps_o = \{DC_{i,Ad} \bigoplus s, DC_{i,Ad} \bigoplus \bar{s}, DC_{i,Ad}\}$ = each element in *p* added to Addresse commitments, plus an **option of an unchanged** $DC_{i,Ad}$.

-oo marks a question for being non-intrusive. *-oo*'s role is to signal widening of ps_o to include, besides context states in which the Addressee resolves the issue, a context state in which he does not. Interrogatives place an inquisitive proposition on the Table and project canonical states in which the Addressee volunteers information that settles the issue. Adding a non-intrusive marker allows the Addressee to comply without volunteering such information, either because he doesn't have it or because he doesn't wish or is not willing to provide it. The Speaker is still seen as wishing to have the issue resolved; if he didn't, he could have remained silent. *-oo* marked interrogatives are appropriate when the Addressee is assumed to know the true answer, but the context justifies asking a 'softened' question, and also in contexts in which the Addressee is not assumed to know the answer.

Similarly in *wh*-exclamatives, we propose that *-oo* signals domain widening. The exact nature of the domain widening that *-oo* is signalling in exclamatives is elaborated in the next section.

4. A unified analysis for *wh*-exclamatives

4.1. Starting with Type2 *wh*-exclamatives

The Type2 *wh*-exclamative is repeated here, (49), from Telugu and German.

(49) a. **evar-ni** pelli-ceesukund-oo!
who-m married-OO
'Whom (she) married!'

b. wen DIE geheiratet hat!
whom she married has
'Whom she married!'

The problem for the ZP analysis with Type2 *wh*-exclamatives is that the Karttunen denotation (true answers) won't work for determining the set of alternatives, as there there is only one alternative. Our solution to this problem is to consider the alternatives that are the *wh*-focus alternatives, the Hamblin alternatives.

Another issue is how to arrive at D_1, the initial domain that undergoes domain widening. Our solution is to consider the Expectation Set (already in Rett 2011, Rett and Murray 2013) —the Speaker's expectations are encoded as sets of possible worlds, the Expectation Set (ES).

And finally, the last piece of the puzzle is how the alternatives are ordered. Our solution is that they are ordered based on likelihood (like *even*). Now the widening analysis works, the true answer is to be found in the widened domain, (50).

$$(50)\quad \left\{ \begin{array}{l} \left\{ \begin{array}{l} \text{She married Kiran} \\ \text{She married Bhanu} \end{array} \right\}^{ES} \\ \textbf{She married Ravi} \end{array} \right\}^{D_2}$$

4.2. Moving on to Type1 *wh*-exclamatives

The Type1 *wh*-exclamative is repeated here, (51).

(51) a. **enta** vinta dosalu tinTaaD-oo!
how weird dosas eats-OO
'What weird dosas (he) eats!'

b. **eemi** dosalu tinTaaD-oo!
what dosas eats-OO
'What dosas (he) eats!'

In a Type1 *wh*-exclamative, the alternatives are ordered by a gradability scale, (52).

$$(52)\quad \left\{ \begin{array}{l} \left\{ \begin{array}{l} \textbf{He eats plain dosas} \\ \text{He eats masala dosas} \end{array} \right\}^{ES} \\ \text{He eats chicken dosas} \\ \textbf{He eats pepperoni dosas} \end{array} \right\}^{D_2}$$

We reformulate ZP's WIDENING (signalled in Telugu/Kannada by *-oo*) to work with hamblin alternatives, (53).

(53) For any clause *S* with Op_{EXCLM}, widen initial domain *ES*, to new domain, D_2, such that:

a. $[\![S]\!]_{w,D_2,\prec} - [\![S]\!]_{w,D_{ES},\prec} \neq 0$

b. $\forall x \forall y[(x \in D_{ES} \& y \in (D_2 - D_{ES})) \rightarrow x \prec y]$

c. $\exists p \in [\![S]\!]_{w,D_2,\prec} - [\![S]\!]_{w,D_{ES},\prec}$ is true.

4.3. Alternatives in coincidence scenarios

Our analysis still cannot account for the alternatives in the repeated/matching coincidence scenarios, (54).

Context: Think of a whole number between [1-12] and Ravi will guess it:

(54) eemi/ee number guess ceeseeD-oo!
what number guess do-OO
'What/Which number he guessed!'

Here the domain of alternatives is 1 to 12 . All have equal likelihood. Then, the question is how does domain widening work.

We propose that here the alternatives have to be identified in terms of conceptual covers (Aloni 2001), instead of entities. Conceptual covers are different ways of conceiving the elements of the domain. The question is relativized to contextually given conceptual covers, (55).

(55) CC = $\{\lambda w[\text{number thought of}]_w, \lambda w[\text{number not thought of}]_w\}$

Thus the guessing-game alternatives are: [He guessed a number I thought of] and [He guessed a number I didn't think of]. This satisfies the Uniqueness condition: In no world is an individual counted twice; and the Existential condition: Each individual is identified by at least one concept.

Now the alternatives are not of equal likelihood, since the likelihood of guessing a number not thought of is much more than guessing the number thought of. Thus the alternatives can be ordered on the likelihood scale.

Some evidence for this analysis comes from a possible answer to the question, 'What number did he guess?' The answer can be: *adee number* 'same number' (that I thought of). Also quantifying into the exclamative gives further evidence: *prati saari eemi number guess ceeseeDoo!* 'Each time what number he guessed!'

4.4. Two Expectation Sets: Speaker & Norm

It is known that not every *wh*-exclamative expresses surprise, (56). In this sentence the exclamation is expressing that the curry is hotter than normal, but not exceeding the speaker's expectations.

(56) It is not surprising how very hot the curry is!

We model this in our analysis by setting the Expectation Set to the normative set, i.e. ES_{NORM} when the expression is not surprise.

When the Speaker's expectations are exceeded, and the expression is that of surprise, (57), we model that in our analysis by setting the Expectation Set to that of the Speaker, i.e. ES_{SPKR}, so that Speaker's expectations are exceeded, even if normative ones are not.

(57) How very cold it is! (says someone with a fever, even as it is warm outside.)

In Telugu, *wh*-exclamatives can express surprise or not, (58a), but the dem(onstrative)-exclamatives are exclusively surprise expressing, (58b). So going by our analysis, the *wh*-exclamative can take either ES_{SPKR} or ES_{NORM}, whereas the *dem*-exclamative can only take ES_{SPKR}.

(58) a. kuura **enta** baagund-oo!
curry how-much nice-OO
'How nice the curry is!'

b. kuura **inta** baagund-ee!
curry this-much nice-EE
'The curry is SO nice!'

In Mandarin, Badan and Cheng (2015), one exclamative type is exclusively surprise, (59), and another exclusively non surprise, (60). Therefore we conclude that the first takes ES_{SPKR} and the second ES_{NORM}.

(59) Nǐ de wǎncān duōme hǎo a!
You DE dinner much.ME good SFP
'How delicious your dinner is!'

(60) Nǐ de wǎncān zhème hǎo a!
You DE dinner this.ME good SFP
'How delicious your dinner is!'

4.5. Denotation to Dynamic Discourse effect

The *wh*-exclamative denotation that we have arrived at so far in our analysis is given in (61).

(61) $\exists$p.p$\in D_{2\prec} - ES_{\prec}$ is true (where *p* is one of the ordered Hamblin alternative, ES is the ExpectationSet, and D_2 is the widened domain signalled by *-oo*)

What is this denotatum used to do? How does it change the context? What is the discourse update of the *wh*-exclamative? How do the perceived effects of the *wh*-exclamative come about, based on the denotation proposed? We propose that the discoure update of the exclamative is to add the proposition to the Firm Commitments (FC) of the Speaker, (62).

(62) Add $\{p\}$ to FC_{spkr}

This is its *descriptive content*. But does any other part of the discourse structure get updated or downdated? What about the *expressive content*? Rett (2018) proposes that exclamations update the Discourse Commitments of the Speaker as a pair of propositional attitude and proposition, (63).

(63) $DC_{o,S} = DC_{i,S} \cup \langle \texttt{is-surprised},\ p \rangle$

But as we saw, there are non-surprise expressions of wh-exclamatives, and they are too varying and wide-ranging to be captured as DC updates. We leave them out as pragmatic inferences of WIDENING.

4.6. Back to Grimshaw: Explaining Factivity

How do we explain the factivity generalization of English? We propose that in English, $\{p\}$ gets added to the Common Ground (CG) directly, making this an automatic dynamic update, which is not-at-issue. This derives the factivity restriction of English *wh*-exclamatives.

The Telugu facts are different –*wh*-exclamatives are embeddable under *think* and *say*, (64).

(64) ravi eemi baagaa aaDeeDoo anukunnaa
Ravi what well played-oo thought
'I thought how very well Ravi played.'

So in Telugu, $\{p\}$ does not get added to CG directly. This allows *wh*-exclamatives to be embedded under anti-factives like *think*.

4.7. Cross-linguistic variation: Strictly Type1 *wh*-exclamative languages

How do we explain the cross-linguistic differences? We propose that there are two variants of the operator, tuned to the choice of the scale –degree or likelihood. English, Catalan, and Swedish only have access to the degree scale in matrix *wh*-exclamatives, (65). However, English embedded *wh*-exclamatives have access to the likelihood scale or the embedding predicate does, since in English, Type2 exclamatives are possible in embedded contexts.

(65) For any clause *S* with $\mathrm{Op}_{\mathrm{EXCLM}}$, widen initial domain *ES*, to new domain, D_2, such that:
a. $[\![\mathrm{S}]\!]_{w,D_2,\prec_{degree}} - [\![\mathrm{S}]\!]_{w,D_{ES},\prec_{degree}} \neq 0$
b. $\forall x \forall y[(x \in \mathrm{D}_{ES} \& \ y \in (\mathrm{D}_2 - \mathrm{D}_{ES})) \rightarrow x \prec_{degree} y]$
c. $\exists p \in [\![\mathrm{S}]\!]_{w,D_2,\prec_{degree}} - [\![\mathrm{S}]\!]_{w,D_{ES},\prec_{degree}}$ is true.

Dutch, German, Hungarian, Telugu, and Kannada have access to the likelihood scale in matrix *wh*-exclamatives, (66).

(66) For any clause *S* with $\mathrm{Op}_{\mathrm{EXCLM}}$, widen initial domain *ES*, to new domain, D_2, such that:
a. $[\![\mathrm{S}]\!]_{w,D_2,\prec_{likelihood}} - [\![\mathrm{S}]\!]_{w,D_{ES},\prec_{likelihood}} \neq 0$
b. $\forall x \forall y[(x \in \mathrm{D}_{ES} \& \ y \in (\mathrm{D}_2 - \mathrm{D}_{ES})) \rightarrow x \prec_{likelihood} y]$
c. $\exists p \in [\![\mathrm{S}]\!]_{w,D_2,\prec_{likelihood}} - [\![\mathrm{S}]\!]_{w,D_{ES},\prec_{likelihood}}$ is true.

4.8. Type1 = flexible vs. Type2 = inflexible word-order

We go with Lipták (2005) in saying that the V-2 and V-final word order differences are syntactic. In Hungarian, the canonical-order allows for both high amount and low amount readings, the non-canonical order only for high amount readings. This has to do with the quantificational projection rather than the scale available. *ManyP* in Hungarian is in fact a specialized projection for high amount evaluatives. Items lexically or morphologically marked for amount/plurality can occupy the quantificational position, which is V-2. This explains the V-2 vs. V-final order difference in German and Dutch *wh*-exclamatives, where V-2 can host only Type1 *wh*-exclamatives, whereas V-final can host Type1 or Type2 *wh*-exclamatives.

5. Conclusion

The final mechanism that we propose as to how an exclamative (whether *wh*- or otherwise, whether Type1 or Type2) works i.e. the semantic/pragmatic mechanism of exclamatives is the following:

1. Generating alternatives:
   - wh-focus
   - other focus mechanisms
2. scale to order the alternatives:
   - lexical degree scale, or degree morpheme in structure

- likelihood scale

3. Widening and Dynamic update:
   - Widening of domain from ES to D_2
   - Add {p} to FC_{spkr}

$$\left\{ \text{Alt}_1, \text{Alt}_2, \text{Alt}_3 \right\} \overset{likelihood/degree}{\rightarrow} \left\{ \begin{array}{c} \text{Alt}_1 \\ \text{Alt}_2 \\ \text{Alt}_3 \end{array} \right\} \rightarrow \left\{ \begin{array}{c} \left\{ \begin{array}{c} \text{Alt}_1 \\ \text{Alt}_2 \end{array} \right\}^{ES} \\ \textbf{Alt}_3 \end{array} \right\}^{D_2} \rightarrow \text{Add } \{p\} \text{ to } FC_{Spkr}$$

here p = $\exists q \in [\![\text{ S }]\!]_{w,D_2,\prec_{likelihood/degree}} - [\![\text{ S }]\!]_{w,D_{ES},\prec_{likelihood/degree}}$ is true.[3]

Cross-linguistic points of variation can be attributed to three places in the interpretation that give rise to cross-linguistic parametric variation or differences between various exclamative types in the same language:

1. choice of scale:
   - degree = Type1 reading
   - likelihood = Type2 reading
2. choice of ES:
   - Speaker = Surprise
   - Normative = No surprise
3. Choice of update to CG:
   - Add {p} to CG = Factivity
   - Don't add {p} to CG = No Factivity

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[3]Here, $p = \text{Alt}_3$, in this illustration.

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Pronouns, null arguments, and ellipsis in Mandarin Chinese[1]

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Abstract. This paper argues that both overt and null pronouns in Mandarin are the elliptical counterparts of corresponding overt noun phrases. Specifically, null pronouns are the pronominal counterparts of bare nouns, which are typically restricted to unique definite environments, while overt pronouns are the pronominal counterparts of demonstrative descriptions, which are typically restricted to anaphoric definite environments. This result provides support for a hypothesis we call *Determiner-Pronoun Parallelism*: the idea that a language's pronominal inventory is isomorphic to its determiners used for the expression of definiteness distinctions.

Keywords: pronouns, ellipsis, determiner, definiteness, anaphora, Mandarin.

1. Introduction

Mandarin is one of many languages where both subjects and objects can be null given the proper discourse context (Huang, 1984). In such contexts, they seem to serve as translational equivalents of overt pronouns:

(1) a. (ta) lai-le.
(s/he) came-PERF
'S/he came.'
b. Lisi hen xihuan (ta).
Lisi very like (him/her)
'Lisi likes him/her very much.' (Huang, 1984: p. 537)

Given the equivalence of overt pronouns and null arguments, one common approach has been to analyze null arguments as the deleted counterpart of overt pronouns (e.g. Neeleman and Szendröi, 2007).

We demonstrate in this paper that such a view is mistaken: overt and covert pronouns often occur in distinct semantic contexts and, therefore, null pronouns cannot simply be the deleted counterpart of the former. Restricting our focus to third person pronouns, we propose that null and overt pronouns are derived from semantically distinct DPs via ellipsis. Specifically, while null pronouns are the pronominal counterpart of unique definite determiners, the overt pronoun (*ta*) is interpreted as a variable ranging over indices; they are arguments of anaphoric definite determiners:

(2) *Mandarin null pronoun via ellipsis*
a. $\varnothing_\iota$ *xuesheng* $\longrightarrow \varnothing_\iota$
the$_{\text{unique}}$ student
b. $[\![(2a)]\!] = \iota x[\text{student}(x)]$

[1]We would like to thank audiences at UC Berkeley and at Sinn und Bedeutung in Barcelona for their comments and questions, and friends and family for providing their judgments on the Mandarin examples. Authors are listed alphabetically by last names.

Proceedings of Sinn und Bedeutung 23, vol. 1, pp. 127–142. Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès).

(3) *Mandarin overt pronoun via ellipsis*

a. *(ta) na ge xuesheng* $\longrightarrow$ *ta*
s/he that$_{\text{anaphoric}}$ CL student

b. $[\![(3a)]\!]^g = \iota x[\text{student}(x) \wedge x = g(1)]$

The distinction in Mandarin directly reflects a distinction in Mandarin definites discussed in Jenks (2018). Similar semantic distinctions for weak versus strong pronouns have been made for German (Patel-Grosz and Grosz, 2017) and Tswefap (Clem, 2017). We conjecture that this parallelism is no coincidence: if pronouns are generally derived from overt noun phrases by ellipsis, then the pronominal system of a languages will reflect its determiner system.

2. Definiteness distinctions and their pronominal counterparts

Schwarz (2009) demonstrates that a morphological distinction between weak and strong definite articles in German has a semantic basis: the weak definite article occurs in unique definite contexts, and the strong definite article occurs in familiar/anaphoric definite contexts. Patel-Grosz and Grosz (2017) propose that this distinction is mirrored in the structural distinction between pronouns in German. Specifically, weak definite articles and personal pronouns lack a semantic index and are structurally small, while strong definite articles and demonstrative pronouns project an index and are, hence, structurally large. Evidence for this distinction in pronouns comes from, for example, the fact that personal pronouns sometimes can be used without an explicit antecedent:

(4) a. Wenn ich schwanger werde, werde ich {es / #das} auf jeden Fall behalten.
if I pregnant become will I it DEM on every case keep
'If I get pregnant, I will definitely keep it / #DEM(= the baby).'

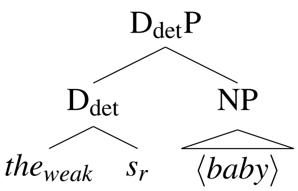
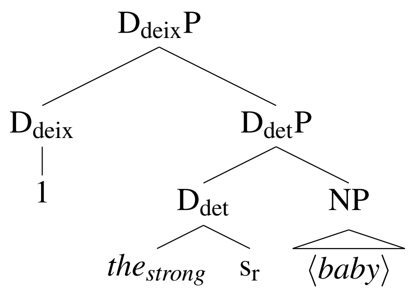
b. Wenn ich ein Kind kriege, werde ich {es / das} auf jeden Fall behalten.
if I a child get will I it DEM on every case keep
'If I have a child, I will definitely keep it / DEM(= the baby).'

(Patel-Grosz & Grosz 2010:349)

(4a) is an appropriate context for a unique definite description (*the baby*) but not an anaphoric definite description, as there is no overt prior mention of a baby.

The syntax and semantics below captures this contrast (Patel-Grosz and Grosz, 2017: pg. 262):

(5)

	Personal pronoun	*Demonstrative pronoun*
Syntax		
Semantics	$[\![D_{det}P]\!]^g = \iota x[\text{baby}(x)(s_r)]$	$[\![D_{deix}P]\!]^g = \iota x[\text{baby}(x)(s_r) \wedge x = g(1)]$

Both kinds of definite articles take as their first argument a resource situation (s_r), which provides a contextual domain restriction (Elbourne, 2005). Demonstrative pronouns include an additional DeixP projection (cf. Cheng et al., 2017), and the index in the demonstrative pronoun must be bound by a discourse antecedent. The deleted NP is semantically recoverable.

Clem (2017) records a similar situation in Tswefap (Grassfields Bantu), claiming that only the strong pronoun/definite contains a semantic index. While the details of definiteness in Tswefap are not clear, it is significant that the strong pronoun can function as an article, and that bare nouns independently can receive definite interpretations in Tswefap, as in Mandarin.

The parallels between pronouns and definite noun phrases in German and Tswefap suggest the following conjecture:

(6) *Determiner-pronoun parallelism:* Whatever distinction a language makes in its definiteness system will be mirrored in its pronominal system.

In addition to capturing the observed connections between definiteness and pronouns in German and Tswefap, *determiner-pronoun parallelism* is predicted by the D-type analysis of pronouns of Elbourne (2001, 2005), in which pronouns are analyzed as definite articles with deleted NPs. Applied to languages with a grammatical distinction between anaphoric and unique definites, Elbourne's theory straightforwardly predicts the definite expressions of a language might be reflected in its pronominal system, as simple NP ellipsis should permit the underlying semantics of a D head to survive.

Some additional evidence that (6) is on the right track comes from an unexpected place: languages like Mandarin without definite articles:

(7) *Discourse pro-drop generalization:* Languages that allow discourse pro-drop — Japanese, Chinese, Korean — allow (robust) bare NP arguments.
(Tomioka, 2003, cf. Barbosa, To appear)

Tomioka (2003) argues that this generalization holds because null arguments always include null property anaphora (or ellipsis), exactly as we might expect under the D-type analysis of pronouns.

Now Jenks (2018) shows that despite lacking a definite article, Mandarin distinguishes unique and anaphoric definites, like German. In Mandarin, bare nouns are used in unique definite contexts, such as to refer to the moon in (8a), while demonstrative descriptions occur in anaphoric definite contexts, such as the donkey anaphor in (8b):

(8) a. **yueliang** sheng shang lai le.
moon rise up come PERF
'The moon has risen.' (Chen, 2004: p. 1165)

b. ni jiao shei jin-lai, wo dou jian **na ge ren**.
you ask who enter, I all see that CLF person.
'Whoever you ask to come in, I'll see that person.' (Jenks, 2018: p. 511)

Jenks proposes an analysis of this contrast analogous to the distinction between unique and anaphoric definites in German as above, where the latter contains an additional argument, an variable interpreted relative to some interpretation function g.

(9) a. $[\![\text{yueliang}]\!]^g = \iota x[\text{moon}(x)(\text{s}_r)]$ = 'the unique moon in s_r'
b. $[\![\text{na ge ren}]\!]^g = \iota x[\text{person}(x)(\text{s}_\text{r}) \wedge x = g(1)]$ = 'the unique person in s_r identical to $g(1)$'

By *determiner-pronoun parallelism* (6), we predict that if null arguments/pronouns are the pronominal counterpart of bare nouns in Mandarin, as predicted by Tomioka, some pronominal category might be the counterpart of demonstratives. In the following section we show that overt pronouns serve this function in Mandarin, building on Bi (2018).

3. Null versus overt pronouns in Mandarin

This section provides evidence for the following generalization about null versus overt pronouns in Mandarin.

(10) a. Null arguments (= ∅) have a parallel distribution to bare definite nouns, and, in turn, to unique definites;
b. Overt pronouns (= *ta*) have a parallel distribution to complex demonstratives, and, in turn, to anaphoric definites.

After establishing the generalization in this section, in the following section we derive the parallel by proposing an ellipsis-based account of both kinds of pronouns.

One complication is that there are a number of differences in the status of null subjects and objects in Mandarin, surveyed by Li (2014). For examples, null objects can receive indefinite interpretations, but null subjects cannot. Additionally, embedded null subjects are subject-oriented anaphora, and must be bound by the closest c-commanding subject. Overt pronouns also differ in the two positions: overt embedded subject pronouns cannot be interpreted as bound variables, while this restriction does not obtain for overt object pronouns Huang (1991). This asymmetry is absent in many other null subject languages such as Japanese, and has motivated the proposal that the status of null subjects and null objects is fundamentally different in Mandarin (Saito, 2007; Miyagawa, 2010; Tomioka, 2014). However, contrary to the expectations of this work, we show that the generalization in (10) obtains in both subject and object positions, yet we steer clear of embedded subject positions, which appear to have a somewhat different status (for discussion, see Barbosa, To appear).

3.1. Contexts prohibiting overt pronouns

The following four contexts are incompatible with overt pronouns in Mandarin, and only allow null arguments:

(11) Contexts requiring null pronouns in Mandarin
a. Anaphora to indefinites under the scope of negation ('bathroom sentences')
b. Situation-dependent covariation ('president sentences')
c. Anaphora to implicit antecedents
d. Anaphora to globally unique definites

Bare nouns, as unique definites, are required in the same contexts (Jenks, 2018, Appendix A).

We begin with so-called 'bathroom sentences' (attributed to Barbara Partee by Roberts (1989)), in which an indefinite antecedent is under the scope of negation. Because of its scopal properties, this indefinite does not introduce an individual to the discourse. Nevertheless, pronominal reference to the antencedent is possible in languages like English. In Mandarin, anaphora to indefinites under the scope of negation must be null; overt pronouns are prohibited (Bi, 2018). This restriction obtains for subjects (12) and objects (13).

(12) zhe-dong lou yaome mei-you xishoujian$_1$, yaome $\varnothing_1$/#ta$_1$ jiu zai qiguaide difang.
this-CLF building either not-have bathroom or (it) then in weird place
'Either this building does not have a bathroom, or it is in a funny place.'

(13) tushuguan yaome mei-you zixishi$_1$, yaome jiu yijing youren yuding-le $\varnothing_1$/#ta$_1$.
library either not-have study.room or then already someone reserve-PERF (it)
'Either the library does not have a study room, or someone has reserved it.'

These facts indicate that overt pronouns must refer to actual entities in the range of a contextual assignment function, but null pronouns are not subject to this restriction.[2]

The same contrast was noted for Japanese by Kurafuji (1998, 1999), who also concluded from these facts that the two types of pronouns have distinct interpretations. However, Elbourne (2005: pp. 40-45) takes issue with Kurfuji's conclusion, pointing out that the relevant overt pronoun in Japanese is a demonstrative pronoun, which Elbourne argues may be ruled out for independent reasons in bathroom sentences. Elbourne's argument does not carry over to Mandarin, however. This is becuase *ta* 's/he, it' is a personal pronoun, distinct from the demonstrative pronoun *na-ge* (see Section 6). Bi's replication of the Japanese facts in Mandarin resurrects the plausibility of Kurafuji's original explanation: overt pronouns in Japanese, like Mandarin, cannot access indefinite antecedents under the scope of negation because they require an discourse antecedent.

The second context where overt pronouns are impossible is *situation-dependent covariation*, or President sentences (Evans, 1977). In these contexts the antecedent is a unique definite, but the anaphor refers to a different individual who has the same unique role, here that of a president, in a different context. In these contexs, null arguments allow sloppy readings which covary with situations, but overt pronouns always pick out the same individual over distinct situations.

[2]One interesting complication is that this effect is somewhat weaker with a human antecedent, as illustrated with the following two sentences:

(i) zhe-jia shangdian yaome mei-you shouyinyuan$_1$, yaome $\varnothing_1$/ta$_1$ jiu zai wuxiu.
this-CLF store either not-have cashier or (s/he) then PROG lunch.break
'Either this store does not have a cashier, or s/he is on a lunch break.'

(ii) zhe-jia ren yaome mei-you xiaohai$_1$, yaome $\varnothing_1$/?ta$_1$ jiu bei lingyang-le.
this-CLF people either not-have baby or (it) then PASS adopt-PERF
'Either this family does not have a baby, or it is given up for adoption.'

In the first example, with antecedent *shouyinyuan* 'cashier,' an overt pronoun is grammatical. In the second sentence, however, the antecedent *xiaohai* 'baby,' is somewhere in between, with a preference for the null pronoun. The account discussed below can extend to these facts as long as human nouns like *shouyinyuan* 'cashier' can introduce a discourse referent in these contexts, scoping above negation, while inanimate nouns (or babies) do not.

(14) qunian, zongtong$_1$ shi minzhudang ren. jinnian, #ta$_1$/$\varnothing_2$ shi gonghedang ren.
last.year president is democrat person this.year (he) is republican person
'Last year, the president was a democrat. This year, s/he is a republican.'

(15) zai faguo, měigeren dou xihuan zongtong. dan zai meiguo, méiren xihuan #ta$_1$/$\varnothing_2$.
in France everyone all like president but in America nobody like (him)
'In France, everybody likes the President (=Macron). But in the US, nobody likes him (=Trump).'

In the analysis we adopt below, the index of the overt pronoun forces it to refer *de re* across situations. The null pronoun lacks an index, and, as a result, can covary along with a situation (cf. Elbourne, 2005; Schwarz, 2009). We return to an analysis of these facts in Section 4.

The next context where null and overt pronouns contrast involves *implicit antecedents*. While pronouns almost always require overt antecedents, there are a few exceptional contexts for which this restriction is weakened, such as the sentences below. In these contexts, null arguments are perfectly grammatical, but overt pronouns are not.

(16) a. wo ruguo huaiyun-le, jiu yiding hui liuxia ∅/??ta.
I if pregnant-PERF then definitely will keep
'If I get pregnant, I will definitely keep (him/her).'

b. wo ruoguo you-le haizi$_i$, jiu yiding hui liuxia $\varnothing_i$/ta$_i$.
I if have-PERF baby then definitely will keep (him/her)
'If I have a baby, I will definitely keep (him/her).'

These sentences indicate that overt pronouns require an explicit discourse antecedent, a requirement dubbed *strong familiarity* by Roberts (2003). This observation replicates the German examples in (4), where personal pronouns are possible but demonstrative pronouns are not.

Finally, *globally unique definites* only allow null anaphora as continuations, not overt pronouns:

(17) Zhangsan xihuan yueliang$_i$. Lisi taoyan $\varnothing_i$/#ta$_i$.
Z. like moon L. hate
'Zhangsan likes the moon. Lisi hates it.'

(18) Zhangsan xihuan yueliang. ∅/#ta zong rang ta xiangqi jiaxiang.
Z. like moon (it) always make him think.of hometown
'Z. likes the moon. It always reminds him of his hometown.'

There is a bit more speaker variation in this example. Some Mandarin speakers do not object to an overt subject pronoun in (18b), other dislike either kind of pronoun. When the overt pronoun does occur, it implicates the existence of a second moon, for example, this sentence would be fine if we lived on two-mooned Mars. Note that this kind of anti-uniqueness requirement is reminiscent of demonstratives. We propose that there is a strong pragmatic preference against using anaphoric definites for globally unique definites, even when they have discourse antecedents, perhaps because speakers do not bother to index universally available referents, where there can be no mistake about the intended referent.

3.2. Contexts allowing overt pronouns

The following three contexts are compatible with, or require, an overt pronoun.

(19) Contexts requiring an overt index:
  a. Exophoric reference
  b. Narrative sequences
  c. Donkey sentences

We will argue that overt pronouns are required in these contexts because they require or prefer an overt semantic index. Tellingly, demonstrative descriptions, as anaphoric definites, are required in these contexts as well (Appendix A), a requirement that Jenks (2018) suggests is due to a principle *Index!*, which requires overt indices when they are available. However, in the contexts above some speakers still permit null pronouns, even though they may prefer for overt pronouns. We also find a subject-object asymmetry in this preference: null pronouns are more often available in subject position than object position.

First, exophoric or deictic reference requires overt pronouns; null pronouns are prohibited:

(20) wo zhichi ta/#∅. [pointing]
I support him/her
'I support him/her.'

(21) ta/#∅ hen congming. [pointing]
S/he very smart.
'S/he is very smart.'

Finger-pointing supplies an assignment for an index (cf. Schlenker, 2011 on signed languages). The distinction between pronominal types in this context are robust in both subject and object position.

We turn now to anaphoric or familiar definite environments, the classic instance of which is narrative sequences (Karttunen, 1976). In these contexts an indefinite antecedent introduces a discourse referent which is taken up by a pronoun in the following sentence.

(22) jiaoshi wai you yi-ge xuesheng$_1$. ta$_1$/$\varnothing_1$ kanjian-le Lisi.
classroom outside have one-CLF student (s/he) see-PERF L.
'There is a student outside the classroom. S/he saw Lisi.'

(23) you yi-ge xuesheng zhan-zai Zhangsan bangongshi men-wai. Zhangsan
have one-CLF student stand-at Z. office door-outside Z.
jian-le ta$_1$/#$\varnothing_1$.
see-PERF *(him/her)
'There is a student outside Zhangsan's office. Zhangsan meet with him/her.'

In the object position of a narrative sequence, the preference for an overt pronoun is relatively sharp. However, both anaphoric null pronouns and null arguments are possible in subject position, a fact which mirrors the distribution of bare nouns and demonstratives in these environments, as discussed further in Section 5.

The third context is donkey sentences, which have been observed to pattern with anaphoric definites in Jenks (2018). The sentences below include donkey anaphora with quantificational antecedents and in *ruoguo* conditionals, the two ways of forming donkey dependencies in Mandarin that make use of a definite anaphor. We see that once again, a sharp contrast emerges on object position.

(24) mei-ge you lüzi$_1$ de nongfu dou hui da ta$_1$/#$\varnothing_1$.
every-CLF have donkey DE farmer all will beat *(it)
'Every farmer who owns a donkey$_i$ beats it$_i$.'

(25) yi-ge nüren$_1$ ruguo you haizi$_2$, ta$_1$/$\varnothing_1$ jiu hui hen ai ta$_2$/#$\varnothing_2$.
one-CLF women if have child, she then will very love *(her)
'If a woman has a child, she will love her very much.'

However, example (25) shows that null subjects allow covarying interpretations in conditionals, paralleling the exceptional availability of null subjects in narrative sequences.

The table below summarizes the distribution of overt and null pronouns in unique contexts versus what we call indexing contexts, a cover term for exophoric reference and anaphoric definite contexts.

(26) *Distribution of* ta *vs.* $\varnothing$

	ta		$\varnothing$	
	SUBJ	OBJ	SUBJ	OBJ
UNIQUE CONTEXTS				
Bathroom sentence	✗	✗	✓	✓
President sentence	✗	✗	✓	✓
Implicit antecedent	✗	✗	(✗)	✓
Globally unique	✗	✗	✓	✓
INDEXING CONTEXTS				
Pointing	✓	✓	✗	✗
Narrative sequence	✓	✓	✓	✗
Donkey sentence	✓	✓	✓	✗

Subjects and objects pattern together in unique and indexing contexts, with the availability of null subjects in anaphoric definite environments forming the exception, an issue we return to in Section 5. Crucially, null pronouns are always possible in both subject and object position in unique contexts, while overt pronouns are always possible in both subject and object position in indexing contexts. We conclude there exists some semantic distinction between overt versus covert pronouns which obtains in subject and object positions.

4. Pronouns as concealed definite descriptions

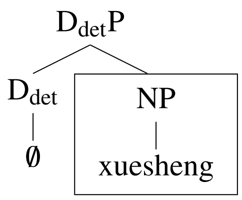
Following work by Evans (1977) and Cooper (1979), Elbourne (2001, 2005) argues that at least certain pronouns are definite articles with concealed NP complements. Patel-Grosz and Grosz (2017) extend this view to the distinction between personal and demonstrative pronouns in German, splitting DP into two projections corresponding to two types of definiteness.

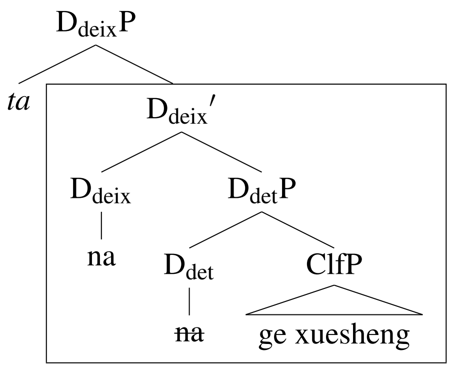
(27) a. D_{det}: the position of articles
b. D_{deix}: a position introducing indices
c. $D_{deix} > D_{det}$

In German, demonstrative pronouns fill both projections, *d-er*, while personal pronouns only fill the lower D_{det}. The insight behind this proposal is that anaphoric pronouns introduce indices into the semantic computation, while other pronouns rely solely on (situation-restricted) uniqueness, as in (5). The introduction of discourse-linked indices is associated with additional structure (Ihsane and Puskás, 2001; Déchaine and Wiltschko, 2003: cf.). This is exactly the semantic distinction needed to account for the distribution of null versus overt pronouns in Mandarin summarized in (26).

Similarly, we propose that null versus overt pronouns occur in distinct sub-projections of D in Mandarin (cf. Cheng et al., 2017). While null pronouns realize a null unique definite article in D_{det}, overt pronouns occur in the specifier of D_{deix}. The D head in such constructions is a demonstrative which moves up from D_{det}, or which occupies a D_{det}-D_{deix} span.

(28) a. *Mandarin null pronoun* b. *Mandarin overt pronoun*





All but the highest overt head or specifier is deleted, the boxed portion of the tree, for both types of pronouns. This proposal is consistent with MaxElide (Merchant, 2004), which generally favors deletion of the largest available constituent.[3]

Evidence for the somewhat elaborate structure for overt pronouns above comes from the ability of such pronouns to occur before anaphoric demonstratives:[4]

(29) [ta na ge xuesheng] hen congming [pointing]
s/he that CLF student very smart
'That student is very smart.'

[3]In the proposal of Patel-Grosz and Grosz (2017); both types of German pronouns realize D heads.

(i) a. *German masculine singular personal pronoun* er
$[_{D_{det}P}$ *er* ⟨NP⟩]
b. *German masculine singular demonstrative pronoun* der
$[_{D_{deix}P}$ *d-* $[_{D_{det}P}$ *-er* ⟨NP⟩]]

The difference in which constituents are deleted in German vs. Mandarin may be a simple consequence of the fact that 1) German lacks an overt indexical pronoun and 2) D_{det} cannot be deleted independent of D_{deix} in German, as they are part of the same word.

[4]These structures only occur with human head NPs. With nonhuman head NPs such as *ta na zhi gou* 's/he that CLF dog,' there is a preference to interpret the pre-demonstrative *ta* as a human possessor, hence, 'her/his dog,' rather than simply 'that dog'. This preference may block the inanimate interpretation of pre-demonstrative *ta*.

(30) yi-ge xuesheng xihuan Lisi. dan Lisi taoyan [ta na ge ren].
one-CLF student likes L. but L. dislike him/her that CLF person
'A student likes Lisi. But Lisi dislikes him/her.'

Huang et al. (2009) argue at length that pronoun-complex demonstrative sequences are not appositive, but form a single DP. Our analysis makes sense of this proposal: the overt pronoun supplies an index to the demonstrative.

There are some complications with this proposal. The first is that overt pronouns are optional with complex demonstratives in anaphoric definite environments. This indicates that there must be a null variant of the index, which is nevertheless distinct from a null pronoun. But ellipsis of Deix′ should not be possible when the pronominal index is silent, lest we wrongly predict that null pronouns are always compatible with anaphoric definite environments. Here, standard proposals about ellipsis licensing come to the rescue: as a general rule, ellipsis is only possible when specifiers are filled (Saito and Murasugi, 1990; Lobeck, 1990). So, we propose that ellipsis of Deix′ is only licensed when its specifier is filled by an overt pronoun.

A second complication is that overt pronominal indices are impossible in some environments, such as with non-human NPs, likely due to a preference for a possessive interpretation for the pronoun in these cases (e.g. *ta na-zhi gou* 'her/his dog', not 'that previously mentioned dog'). In these cases with an overt complex demonstrative, the null pronominal index may be preferred for pragmatic reasons to avoid ambiguity with the possessive interpretation. Again, ellipsis of Deix′ should not be possible when the pronominal index is silent. So the overt index may be possible just in those cases when the Deix′ is deleted with non-human NPs.

The semantics of the unique (∅) versus anaphoric (*na*) variants of $D_{\text{det/deix}}$ are as follows (adapted from Schwarz, 2009, 2013; Patel-Grosz and Grosz, 2017; Jenks, 2018)

(31) a. Unique D_{det} head: $\iota \leftrightarrow \varnothing$
$[\![\iota]\!] = \lambda s_r.\lambda P_{\langle e,\langle s,t\rangle\rangle}.:\exists!x[P(x)(s_r)].\iota x P(x)(s_r)$
b. Anaphoric D_{det} head: $\iota^x \leftrightarrow$ *na* 'that'
$[\![\iota^x]\!] = \lambda s_r.\lambda P_{\langle e,\langle s,t\rangle\rangle}.\lambda y_e.:\exists!x[P(x)(s_r) \wedge x = y].\iota x[P(x)(s_r)]$

In these formulae, *ta* is interpreted as a variable ranging over dynamic indices:

(32) $[\![ta_x]\!]^g = g(x)$

This interpretation accounts for why overt pronouns, as concealed anaphoric definite descriptions — *ta* ⟨*na ge ren*⟩ — must be used in contexts with explicit prior mention or co-speech gesture such as pointing, both of which supply the assignment function with a value for the relevant index. If the context fails to supply a value for this index, as in the contexts outlined subsection 3.1, the assignment function is undefined for this index and reference fails.[5]

These denotations are illustrated for the object president sentences in (15). These sentences are illustrative because the overt pronoun is possible, but not with the covarying, situation-

[5]The one surprise under this view is the infelicity of overt pronouns with larger situation or globally unique definites even in contexts where there is some prior mention, as in (17) and (18). Yet this context has more variability than the others; and pragmatic factors seem to be at play in preferring the null pronoun in order to avoid unwanted implicatures associated with the overt pronoun in unique definite contexts.

dependent interpretation which is available to the null pronoun. We have simplified the situation-semantic representations proposed by Elbourne (2005) for such cases for expository purposes.

Beginning with the covert pronoun, we see that covariation is available by virtue of their bound situation variable.

(33) With $\varnothing$, the remnant of $\varnothing \langle$ *zongtong* $\rangle$ 'the president'

a. $[\![(15)]\!]^g = \lambda s'.\mathbf{in.France}(s') \wedge \forall x[\mathbf{person}(x,s') \rightarrow \mathbf{like}(x, \iota y[\mathbf{president}(y,s')], s')] \wedge \lambda s''.\mathbf{in.USA}(s'') \wedge \neg\exists x[\mathbf{person}(x,s'') \wedge \mathbf{like}(x, \iota y[\mathbf{president}(y,s'')], s'')]$

b. 'In the set of situations s' in France, for every x such that x is a person in s', then x likes the unique individual y such that y is the president in s' in s'. But in the set of situations s'' in the USA, there does not exist an x such that x is a person in s'' and x likes the unique individual y such that y is the president in s'' in s''.'

This means that no individuals in France like Macron, and no individuals in America like Trump, the unique president in the regrettable set of situations in the USA.

We now turn to the reading produced by the overt pronoun; the semantic contribution of the overt pronoun distinct from the null pronoun, which identifies a particular president with a discourse antecedent, has been underlined.

(34) With *ta*, the remnant of *ta* $\langle$ *na-wei zongtong* $\rangle$'s/he that CLF president'

a. $[\![(15)]\!]^g = \lambda s'.\mathbf{in.France}(s') \wedge \forall x[\mathbf{person}(x,s') \rightarrow \mathbf{like}(x, \iota y[\mathbf{president}(y,s')], s')] \wedge \lambda s''.\mathbf{in.USA}(s'') \wedge \neg\exists x[\mathbf{person}(x,s'') \wedge \mathbf{like}(x, \iota y[\mathbf{president}(y,s'')\underline{\wedge y = g(1)}], s'')]$

b. 'In the set of situations s' in France, for every x such that x is a person in s', then x likes the unique individual y such that y is the president in s' in s'. But in the set of situations s'' in the USA, there does not exist a x such that x is a person in s'' and x likes the unique individual y such that y is the president in s'' <u>identical to the discourse referent $g(1)$</u> in s''.'

This means that no Americans like Macron, the unique presidential discourse referent. Macron must be in the range of the assignment function by virtue of his mention in the first clause.

5. Accounting for subject-object asymmetries

Table (26) shows that null pronouns are unexpectedly possible in two anaphoric contexts: narrative sequences (22) and donkey sentences (25). As predicted, this mirrors the distribution of bare nouns, which are possible in anaphoric definite environments in subject position as well:

(35) MANDARIN NARRATIVE SEQUENCES

a. jiaoshi li zuo-zhe yi ge nansheng he yi ge nüsheng,
classroom inside sit-PROG one CLF boy and one CLF girl,
'There is a boy and a girl sitting in the classroom ...

b. Wo zuotian yudao #(**na ge**) **nansheng**
I yesterday meet that CLF boy
'I met the boy yesterday.'

c. Wo dai gei #(**na ge**) **nansheng** yi ge liwu
I bring give that CLF boy one CLF gift
'I'm bringing a gift for the boy.'

d. (**na ge**) **nansheng** kan-qi-lai you er-shi sui zuoyou.
that CLF boy look have two-ten year or-so
'The boy looks twenty-years-old or so.'

e. Wo bu renwei ?(**na ge**) **nansheng** hen youqu.
I NEG think that CLF boy very interesting
'I don't think that the boy is very interesting.' (Jenks, 2018: p. 510)

Anaphoric subjects cannot always be bare nouns in Mandarin; Jenks (2018) shows that one condition that licenses bare nominal subjects is their status as topics.

The correlation between bare nouns and topichood is, of course, not an analysis. There are at least two ways of thinking about the exceptionality of topics: First, it might be the case that some syntactic property of topics (e.g. a [TOPIC] feature) introduces an index in the same manner as a anaphoric or strong definite article does, bringing an index into the picture. The second kind of story is pragmatic: topics are sententially prominent, and as a result can be pragmatically associated with discourse antecedents. Evidence deciding between one of these analyses or some other one, or even a general explanatory framework for understanding them, remains out of grasp.

Aside from these topical contexts, however, Mandarin seems to always prefer explicitly anaphoric definites (overt pronouns or demonstrative descriptions) in contexts that require indices. The exceptionality of null pronouns as topical subjects mirrors the exceptionality of bare nouns as topical subjects, and so the ellipsis analysis extends cleanly to these cases as well.

6. Variation in anaphoric environments

With topical subjects set aside, the boundary between anaphoric definite expressions — both demonstratives and overt pronouns — and unique definite expressions — bare nouns and null pronouns — is quite categorical in Mandarin. This state of affairs differs from German and Japanese, where both strong pronouns (demonstrative or overt) or weak pronouns (personal or null) can occur in donkey sentences ((36)-(37)) and narrative sequences (not shown):

(36) Wenn ein Bauer einen Esel$_1$ hat, dann schlgt er ihn$_1$ / den$_1$.
if a farmer a donkey has then beats he PER DEM
'If a farmer owns a donkey, then he beats it.'
(Wiltschko, 1998: p. 172,Patel-Grosz and Grosz, 2017: p. 278)

(37) Ronbun$_1$-o yon-da dono gakusee-mo sore-o$_1$ / $\varnothing_1$ hihinahi-ta.
paper-ACC read-PAST which student-∀ it-ACC criticize-PAST
'Every student that read a paper criticized it.' (Kurafuji, 1999: p. 131)

These pronominal facts again seem to mirror the state of affairs for full definite descriptions in German, where both unique and anaphoric definites are possible in donkey sentences as well.[6]

(38) Jeder Mann, der ein Haus mit Garten gekauft hat und die meiste Zeit zu Hause
every man that a house with yard bought has and the most time at home
verbringt, arbeitet viel {im / in dem} Garten.
spends works much in=the$_w$ / in the$_s$ garden

[6]Equivalent facts have not been reported for Japanese.

'Every man that bought a house with a yard and spends most of his time at home works a lot in the yard.' (Schwarz, 2009: p. 45, Patel-Grosz and Grosz, 2017: p. 278)

Once again, we find that the distribution of pronouns in German and Japanese parallels the distribution of their definite descriptions. This observation in fact provides a distinct kind of argument for determiner-pronoun parallelism, because whatever must be proposed to account for the wider availability of unique definites in German (and, by conjecture, Japanese) would automatically extend to the wider distribution of null or personal pronouns in both languages.

One possibility is that the types of pronouns which are involved in the different languages are not quite the same. Specifically, what we have been observing in Mandarin is a contrast between personal pronouns and null pronouns. In German, however, the contrast is between demonstrative pronouns and personal pronouns, while in Japanese the contrast seems to be between demonstrative pronouns and null pronouns.

Another indication that the different languages have distinct pronominal contrasts at play is the fact that topicality and anti-topicality play a crucial role in German, where strong pronouns are better with non-topics (Hinterwimmer, 2015). Patel-Grosz and Grosz (2017) observe additional pragmatic factors at play such as dialect indexing. We have seen some indication of the relevance of topicality for Mandarin in that it sometimes exceptionally licenses null pronouns in subject position, as in the previous section, but topicality is often ignored in Mandarin for deference to the requirement that indices be present (e.g. (23)).

In either case, one key to understanding these different pragmatic factors would be a parallel examination of demonstrative pronouns in Mandarin, which do exist, as indicated above, in demonstrative-classifier sequence with a deleted NP complement (e.g. *na-ge (ren)* 'that-CLF (person)'). It seems plausible that these demonstrative pronouns, if they can be so called, are in fact the closest parallel to German and Japanese demonstrative pronouns.

To summarize, the pronominal contrasts in the three languages seems to be as follows:

(39)

Pronoun type:	Demonstrative	Personal	Null
German	der	er	-
Japanese	dono	-	∅
Mandarin	na-ge	ta	∅

We have been focusing on comparing the latter two columns in Mandarin in this paper. The fact that German and Japanese both seem to involve pronominal contrasts with a demonstrative pronoun might provide an explanation for the wider distribution of the weaker member of the pronominal contrast in both languages. It might be the case, for example, that personal pronouns in German actually do have access to indices, like Mandarin personal pronouns. On the other hand, Japanese null pronouns may also have access to indices, unlike their Mandarin counterparts, explaining why they seem to occur in a wider range of contexts than in Mandarin.

7. Conclusion

The central proposal of this paper was the following principle:

(40) *Determiner-pronoun parallelism:* Whatever distinction a language makes in its definiteness system will be mirrored in its pronominal system.

We saw that there is compelling evidence to support this view of pronouns in Mandarin. Either bare nouns or null pronouns are required in definite contexts which lack discourse antecedents. On the other hand, demonstrative descriptions and overt pronouns are only allowed in contexts where such antecedents are available.

This result has implications for the analysis of pronouns more generally. Specifically, to the extent that (40) is true across languages, it provides direct support for the D-type analysis of pronouns proposed by Elbourne (2001), extending it to null pronouns, following Tomioka (2003). In fact, the beauty of the D-type analysis of pronouns is that it captures determiner-pronoun prallalism without any additional stipulations. At the same time, this finding strengthens the growing cross-linguistic support for a mixed approach to E-type anaphora advocated by Chierchia (1995), where both dynamic binding and situations play a role in establishing anaphoric reference across sentence boundaries.

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A. *ta* – demonstrative DP and ∅– bare NP parallels

(41) zhe-dong lou yaome meiyou xishoujian, yaome (#na-jian) xishoujian jiu zai qiguaide
this-CLF building either not-have bathroom or (that-CLF) bathroom then in weird
difang
place
'Either this building does not have a bathroom, or the bathroom is in a funny place.'

(42) tushuguan yaome meiyou zixishi, yaome jiu yijing youren yuding le (#na-jian)
library either not-have study.room or then already someone reserve PERF (that-CLF)
zixishi.
study.room
'Either the library does not have a study room, or someone has already reserved the study room.'

(43) qunian, zongtong shi minzhudang ren. jinnian, (#na-wei) zongtong shi gonghedang
last.year president is democrat person this.year (that-CLF) president is republican
ren.
person
'Last year, the president was a democrat. This year, the president is a republican.'

(44) zai faguo, měigeren dou xihuan zongtong. dan zai meiguo, méiren xihuan (#na-wei)
in France everyone all like president but in America nobody like (that-CLF)
zongtong.
president
'In France, everybody likes President Macron. But in the US, nobody likes President Trump.'

(45) a. wo ruguo huaiyun-le, jiu yiding hui liuxia (??na-ge) haizi.
I if pregnant-ASP then definitely will keep (that-CLF) child
'If I get pregnant, I will definitely keep the baby.'

b. wo ruoguo you-le haizi, jiu yiding hui liuxia (na-ge) haizi.
I if have-ASP baby then definitely will keep (that-CLF) child
'If I have a baby, I will definitely keep the baby.'

(46) Zhangsan xihuan yueliang. Lisi taoyan (#na-lun) yueliang.
Z. like moon L. hate (that-CLF) moon
'Zhangsan likes the moon. Lisi hates the moon.'

(47) Zhangsan xihuan yueliang. (#na-lun) yueliang zong rang ta xiangqi jiaxiang.
Z. like moon (that-CLF) moon always make him think.of hometown
'Zhangsan likes the moon. The moon always reminds him of his hometown.'

(48) wo zhichi #(na-ge) ren. [pointing]
I support that-CLF person
'I support that person.'

(49) #(na-ge) ren hen congming. [pointing]
that-CLF person very smart.
'That person is very smart.'

(50) Zhangsan lingyang-le yi-zhi gou$_1$. (na-zhi) gou$_1$ yao-le Lisi.
Z. adopt-ASP one-CLF dog (that-CLF) dog bite-PERF L.
'Zhangsan adopted a dog. That dog bit Lisi.'

(51) yi-ge xuesheng$_1$ xihuan Lisi. dan Lisi taoyan #(na-ge) xuesheng$_1$.
one-CL student likes L. but L. dislike (that-CLF) student
'A student likes Lisi. But Lisi dislikes the student.'

(52) mei-ge you lüzi$_1$ de nongfu dou hui da #(na-xie) lüzi$_1$.
every-CL have donkey DE farmer all will beat (that-CLF.PL) donkey
'Every farmer who owns donkeys beats those donkeys.'

(53) yi-ge nüren$_1$ ruguo you haizi$_2$, (na-ge) nüren$_1$ jiu hui hen ai #(na-ge) haizi$_2$
one-CLF women if have child, (that-CLF) woman then will very love that-CLF child
'If a woman has a child, the woman will love the child very much.'

Presupposing questions[1]

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Abstract. Utterances like *and the parents are where?* (declarative word-order, non-fronted *wh*-words, and a non-echo interpretation) in languages that in principle have obligatory *wh*-fronting present a challenge. I avoid ad-hoc stipulations by paying attention to the interplay between the semantics of the utterances and their dynamic update. I argue that, in English, such sentences are not interrogatives, but declaratives with vacuous content whose function is to indicate the speaker's presupposition regarding the question to be answered. This system allows us to make predictions about their interpretation while keeping the semantics true to form.

Keywords: *wh*-in-situ, *wh*-questions, dynamic update, discourse models, focus presupposition.

1. Felicity in discourse

Utterances in discourse are subject to felicity constraints. Within a sequence of utterances, a given utterance's 'relevance' is often the principle determining the utterance's felicity. Roughly, for utterances of declaratives and interrogatives, a discourse move (a communicative act) is relevant if it is a (partial) answer to a question or if it posits a question whose answer would help solving the ongoing issue participants have committed to solve. Out of the blue utterances have not, however, received much attention.

In this paper I study an English construction that I dub WhDec, (1a). WhDecs are puzzling because they have a declarative word order (compare with (1b)) containing a non-fronted *wh*-word, and an interpretation that seems similar to that of an (information-seeking) *wh*-interrogative, (1d). In this sense, they are related to rising declaratives (RisDecs), (1c): utterances with declarative word order that request information.[2]

(1)	a.	(And) the boyfriend is where↑?	WhDec
	b.	The boyfriend is in Joshua tree↓.	Dec
	c.	The boyfriend is in Joshua tree↑.	RisDec
	d.	Where is the boyfriend↓?	WhQ

WhDecs present an interesting puzzle. Structurally, we want to understand how an inquisitive utterance with a *wh*-word may allow the *wh*-word to stay 'in-situ'. In order to understand WhDecs I present a thorough examination of the data building on initial explorations in the literature (see e.g. Ginzburg and Sag, 2001; Pires and Taylor, 2007). I show that WhDecs behave differently from WhQs and are not discursively interchangeable, §2. Given that WhDecs are not alone and similar facts can be found in other languages such as Spanish (see Biezma, 2018), the behavior observed in WhDecs is arguably not due to conventionalization and we should be able to derive it in a principled way understanding their semantics and dynamic update.

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[2]In this paper I use '↑' and '↓' to specify the final utterance intonation. '↑' stands for a final rising contour (in ToBI this is corresponds to a nuclear contour with a L* H-H% shape, although there are other possibilities), while '↓' stands for a final falling contour (often H*L-L%, but other shapes are also possible).

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In §3 I introduce the dynamic assumptions (which I adopt from Biezma and Rawlins, 2017b, henceforth B&R), and in §4 I address the semantics and dynamic update of WhDecs, comparing it to regular WhQs and (regular) declaratives. The key to the analysis is that WhDecs are declaratives (not interrogatives) and that they are hence proposals to update the (Stalnakerian) common ground (CG). As declaratives, WhDecs are vacuous (the utterance of (1a) merely establishes that there are different alternatives salient in the context of utterance regarding the whereabouts of the boyfriend). However, via focus anaphora (à la Rooth), it presupposes that there is a question in the context of utterance of the form equivalent to the WhDec's WhQ counterpart (e.g. *where is the boyfriend?* for the running example).[3] This (presupposed) question is left unsolved and, hence, posterior utterances ought to be geared towards solving it and thus creating the mirage that WhDecs are questions themselves.

Before going ahead, let me make two disclaimers. First, the proposal in this paper is centered around American English (although similar phenomena can be observed in Spanish, see Biezma, 2018), where interrogatives are said to exhibit obligatory fronting of the *wh*-word and subject-auxiliary inversion. The proposal is not meant to cover cases observed in so called optional-*wh*-in-situ languages (see Bayer and Cheng to appear for an overview). Second, in this paper I am not concerned with 'echo questions' (EchQs). While echo questions are not necessarily in-situ, the most stereotypical type of echo question shares similarities with WhDecs:

(2) A: The boyfriend is in %@##!%.
B: The boyfriend is WHERE?
L+H* H-H%

As WhDecs, stereotypical EchQs also have an inquisitive interpretation while having a declarative word order. They differ, however, in their prosody: the nuclear contour in EchQs includes a complex accent instead of the simple accent found in WhDecs (see Artstein, 2002 for discussion of the prosody of EchQs). But the class of EchQs is larger. An utterance is identified as an EchQs when it requests information about what was just said in the previous utterance while repeating it verbatim ('echo-ing') to a certain degree. Besides *wh*-in-situ EchQs there are also EchQs with interrogative word order, or non-*wh* EchQs (small caps are used to signal the stressed word carrying the complex accent):

(3) A: I called John.
B: WHO did you call↑? / B': You called JOHN↑?

Addressing the problems presented by EchQs in a comprehensive way that includes all the different types of EchQs is a task beyond the scope of this paper. However, the proposal made for WhDecs in this paper seems a promising way to explain the structural challenges faced by theories of EchQs in explaining in-situ *wh*-EchQs (i.e. explaining why the *wh*-word remains in situ).[4] If it were possible to extend the proposal for WhDecs to the case of in-situ *wh*-EchQs,

[3]That WhDecs are presuppositional was already noticed in Ginzburg and Sag (2001: pg. 280): "It is clear that out of the blue an in-situ *wh*-interrogative clause is typically infelicitous. That is, an in-situ *wh*-clause minimally carries a presupposition of a particular kind. Although the nature of this presupposition is difficult to characterize precisely, we believe that the appropriate account of such presuppositions will provide an appropriate pragmatic explanation for the relative rarity of such uses." Part of what I try to do in this paper is to understand the exact nature of such presupposition while providing an analysis of the semantics and pragmatics of WhDecs.

[4]The reader is referred to e.g. Ginzburg and Sag (2001); Iwata (2003); Sudo (2007); Beck and Reis (2018) for different approaches to EchQs mostly focusing on *wh*-EchQs.

it is likely that we would end up with a picture in which so called EchQs are not structurally fundamentally different from other utterances an in which the term EchQ is merely a cover term including declaratives (RisDecs and WhDecs) and interrogatives (non-*wh*-interrogatives and WhQs) whose echoic interpretation are derived from factors such as information structure.

2. Different ways to inquire about salient alternatives

While WhDecs have not been discussed at length nor have they been the main object of study in the literature (see Pires and Taylor, 2007 for an exception) they have often been mentioned in passing. Example (4a) is from Bolinger (1957), while (4b) is from Kuno and Robinson (1972), and (4d) is from Carlson (1983) from a court setting (see Bartels, 1999 for an overview):[5]

(4) a. A: He was out all night.
B: Didn't get in until when?
H*/L* H-H%/L%
b. [Quizmaster:] The Boston Marathon this year was won by who?
(H*) H* H-H%
c. A: … As always, I'm only going to be here for a few weeks.
B: You're going abroad again when?
H* H-H%
d. [In a court setting] You were informed of the fact on what day?
(H*) H* H-H%/L%

The meaning of these English hybrid-utterances is reported to be discursively linked. Bolinger (1957: p.142) claims that these utterances evoke a previous question and dubs them "reminder questions". However, examples like (4a), (4c) and (4d) show that these are not mere repetitions of other questions and Bartels (1999) points out that often "the speaker merely pretends to rely on a discourse link while knowing that no such link exists." In order to provide a more comprehensive view of the use of WhDecs I present below data from a TV-series *Major Crimes*, Season 5, Episode 1, "Present tense", where information of what precedes WhDecs and what follows them may be observed (Ltn. Provenza below is the highest ranking officer in the conversation and examples sound very natural to native speakers):

(5) [The episode's starting scenes make clear that something has happened to a particular teenage girl, Amanda. We learn that she has gone missing. These scenes are excerpts from her life intertwined with images of people posting signs with her picture advertising her as a missing person. Ltn. Provenza is shown walking to meet his detectives at the place Amanda was last seen while doing volunteer work for a charity, First Care. He needs to be updated on what the detectives have learned so far. (The dialogue presents the very first utterances when they meet)]
Det. Sykes: She hasn't even been gone 48 hours yet.
Det. Oderno: Watch Command didn't take the report seriously because just eight months ago, Amanda ran away from home after having an argument with her parents.

[5] Bartels points out that a final-falling contour is also possible in non-fronted *wh*-utterances when "calling for specification of the agent in the original statement" and are equivalent to narrow focus WhQs that she calls "reference questions" (the label is due to Rando, 1980). (Bartels, 1999: ex. (57)):
(i) A: John knows.
B: John knows what? / What does John Know?
H* L-L% H* L-L%
For reasons of space I only return to the role of intonation briefly in §6, but see Biezma (2019).

Det. Sykes: Let me guess. The fight was over a boyfriend? [RisDec]
H* L- L* H-H%

Det. Oderno: Oh, you must be psychic. Yeah. Parents don't like the age difference. Gabe Young is a graduating senior, and Amanda, she just turned 16 today. Yeah.

Ltn. Prov: Well, let's hold off lighting the candles on her cake for a minute, okay? **And the boyfriend is where?** [WhDec]
L*H L*H-H%

Det. Oderno: Uh, supposed to be camping in Joshua Tree this weekend with friends.

(6) [... The detectives have now reunited with the rest of the unit and they are talking to the First Care Coordinator]

Det. Flynn: (ironically commenting on the safety of the volunteers' tasks) 15-year-old girl approaching strange homeless men at night in downtown L.A.

First Care Coordinator: Not by herself. Gabe, her boyfriend, was helping her, till they had an argument about him missing her birthday for some camping trip.

Ltn. Provenza: **And you know about this argument how?** [WhDec]
L+H* L* H-H%/L-H%

First Care Coordinator: Jenny Stratton, my Outreach Supervisor. I make sure all teenage volunteers work in tandem with adult employees.

The WhDecs utterances above are not preceded by an equivalent inquiry (and all participants are aware of the lack of such antecedent). However, all of them are very much interpreted as requesting information related to the ongoing inquiry.[6]

While WhDecs seem to be similar to WhQs and, e.g., they allow for similar responses, they differ in other aspects. Impressionistically, native speakers report the intuition that WhDecs distill a sense of urgency not obtained from the utterance of the parallel WhQ (without the aid of special prosody). In terms of their distribution, WhDecs distribution is narrower than WhQs and are not possible in (completely) out of the blue situations (contrast (7) with (8) and (9)):[7]

(7) A stops a random pedestrian on the street and says.
A_1: Excuse me, where can I buy an Italian newspaper? [WhQ]
A_2:#Excuse me, I can buy an Italian newspaper where? [WhDec]

WhDecs are possible without a preceding linguistic context as long as the issue is relevant in the utterance situation and we can assume that the addressee is willing take up the question:

(8) A is helping to tidy up after dinner at her friend's house and enters the kitchen carrying the dishes.
A_1: These go where? / A_2: Where do these go?

(9) Professor B is in her office when a delivery-man (A) enters with a pile of packages that are clearly not for her (she is not expecting any package but knows that the office manager is sick at home and her office is next to his):
A_1:#Good morning! I can put these packages where?
A_2: Good morning! Where can I put these packages?

[6]In all instances in which a WhDec is felicitous it can be preceded by *and* or *but*, which in this case are discourse markers (see Asher and Lascarides, 2003 a.o.) indicating that the question is integrated in a larger discourse structure. While WhQs can also be preceded by these markers in some occasions, it's not always possible.
[7]See e.g. Ginzburg and Sag, 2001; Pires and Taylor, 2007 regarding this observation.

The difference between A_1's utterance in (8) and (9) is that in the latter the professor cannot be taken to be willing to solve the delivery-man's issue (even if she knows the answer, it's not her job to be in charge of packages and she may not be willing to busy herself with such issues and help out). Notice also that WhDecs are only felicitous when the spakers considers that the addressee knows the answer or knows whether the answer is known:[8]

(10) [Assuming the same preceding context as in in (5)]
   a. And the boyfriend is where? #Have you checked?
   b. And where is the boyfriend? Have you checked?

Differences between WhDecs and WhQs can also be observed in sequences of questions:

(11) [Lt. Provenza in the same preceding context to the WhDec in (5).]
   a. #Ok, where is the boyfriend? The parents are where?
   b. ?#Ok, and the boyfriend is where? Where are the parents?
   c. Ok, and the boyfriend is where? The parents are where?
   d. Ok, and where is the boyfriend? Where are the parents?

The proposal I make below explains (i) why WhDecs have a more restricted distribution than WhQs, (ii) the restrictions observed in sequences of questions and, (iii) the differences in the overall interpretation between WhDecs and WhQs discussed above.

3. A dynamic system to capture context updates

B&R assume that a context c is formed by a *local context* (l_c), which is composed by the actual context set cs and the QUD stack Q (implemented using a simple alternative-semantics representation) and a *projected context* in which proposals are recorded, ($\mathscr{F}$). This assumption allows them to capture the 'proposal' component of utterances.

(12) A *context* c is a tuple $\langle cs, Q, \mathscr{F} \rangle$ where its elements are characterized as:
   a. $l_c = \langle cs, Q \rangle$ is a local context.
   b. $\mathscr{F}_c$ is either a local context or $\emptyset$. Call $\mathscr{F}_c$ the *projected context*.[9]

(13) A *local context* is a tuple $\langle cs, Q \rangle$ such that:
   a. cs is a context set.
   b. Q is a stack of sets of propositions.

[8] (10a) can be uttered by a lieutenant who wants to convey that the addressee should have inquired already about that information:

(i) Ltn. Provenza arrives at the crime scene and sees that people are very relaxed mingling with people from other units but not much work is being done. He asks quite angrily:
Ltn. Provenza: So, what do we know?
Det. Skyes: The missing person is female. Sandra Smith. She is 15.
Ltn. Provenza: And?!
Det. Sykes: Well, she was last seen here with her boyfriend yesterday at 11:00 pm.
Ltn. Provenza: And?
Det. Sykes: And...?
Ltn. Provenza: (quite irritated) And the boyfriend is where? Have you checked that? Are you doing any detective work?

Notice that in this case the WhDec is 'reporting' the inquiry that he would have liked to have solved previously, which he now suspect can't be answered. Addressing formally these cases is beyond the scope of this paper.

[9] Biezma and Rawlins (2017b) simplify to consider one possible future context or none (notated by $\emptyset$) accepting that in the general case, one may want to allow several future contexts.

The system assumes the standard *push*, *pop* and *top* operations on stacks (see Kaufmann, 2000; Isaacs and Rawlins, 2008).[10] In this model, the current/immediate QUD in the local context l_c will always be at the top of the stack, i.e. given the stack of questions in a context c, Q_c, the current QUD is $top(Q_c)$. The context updates as conversation progresses and declarative utterances propose to update cs while interrogatives propose to update Q:[11]

(14) Local updates. For a local context l,

a. $l \oplus \ulcorner \varphi_{\langle s,t \rangle} \urcorner = \langle cs_l \cap [\![\varphi]\!], Q_l \rangle$ [Declarative update]

Felicity constraints:

(i) cs_l is compatible with $[\![\varphi]\!]$. (assertability)

(ii) $[\![\varphi]\!]$ is relevant to top(Q_l)

b. $l \oslash \ulcorner \varphi_{\{\langle s,t \rangle\}} \urcorner = \langle cs_l, \text{push}(Q_l, [\![\varphi]\!]) \rangle$ [Interrogative update]

Felicity constraints:

(i) cs_l is compatible with $\{w \mid \exists p \in ([\![\varphi]\!]) : p(w)\}$. (answerability)

(ii) $[\![\varphi]\!]$ is relevant to top(Q_l) or $Q_l = \langle\rangle$

In this model, the notion of *relevance* is captured as a constraint on answerhood and question licensing. In an idealization of discourse, declaratives are considered to be answers to a (implicit) question and relevance is relevance to such question. The notion of relevance also specifies the licensing of utterances of interrogatives. (Definitions below are adapted from the notion of relevance in Roberts, 1996.[12])

(15) **Answerhood licensing**: an assertion move is relevant to $top(Q_c)$ only if it entails, either positively or negatively, the resolution of at least one alternative in $top(Q_c)$.

(16) **Question licensing**: a question move is relevant in Q_c only if $Q_c = \langle\rangle$, or it is (part of) a strategy to answer $top(Q_c)$ (where a strategy is a sequence of subquestions that together answer a given question, Roberts, 1996).

B&R assume that presuppositions carried by utterances must be accommodated before the move is accepted (informative updates take place before performing other local updates).[13]

(17) **Accommodation**. If φ presupposes ψ and ψ is not satisfied in l, first update l so that ψ is satisfied.

Finally, full contexts are formed by the current context (the local context) and proposals to update it: the projected context (or 'future context'). The structure of projected contexts is the same as the structure of the local context. The absence of a projected context is notated by $\emptyset$. Given the machinery above, B&R use the following basic definitions:

(18) $c + \ulcorner \text{Assert}(\varphi) \urcorner = \langle cs_c, Q_c, l_c \oplus \ulcorner \varphi \urcorner \rangle$ **Assertion**

Constraints:

a. $\mathscr{F}_c = \emptyset$ b. $l_c \oplus \ulcorner \varphi \urcorner$ is felicitous

[10] I adopt the usual operations on stacks. Given a stack s, $push(s,x)$ delivers the stack resulting from adding x to the top of s. Conversely, $pop(s)$ delivers a stack in which the top element of s has been removed. Finally, $top(s)$ just establishes what's the top element on the stack.

[11] Obviously, Q and cs interact, e.g. cs dictates what the live alternatives in the questions in Q are, and the fact that a particular question has been discussed is recorded in cs.

[12] See Büring (2003) for a more relaxed notion of answerhood. The differences do not matter for our purposes.

[13] This is independent of any specific treatment of presupposition.

(19) $c + \ulcorner \text{Question}(\varphi) \urcorner = \langle cs_c, Q_c, l_c \oslash \ulcorner \varphi \urcorner \rangle$ **Question**
Constraints:
a. $\mathscr{F}_c = \emptyset$ b. $l_c \oslash \ulcorner \varphi \urcorner$ is felicitous

(20) $c + \ulcorner \text{Accept}_x \urcorner = \langle cs_{\mathscr{F}_c}, Q_{\mathscr{F}_c}, \emptyset \rangle$ **Acceptance**

According to the definitions above, utterances do not modify directly the local context but rather the future context: they propose to either add information to the *cs*, in the case of declaratives, or to add a question to the question stack in the case of interrogatives. Acceptance replaces the original context by the future context and leaves the proposal slot (the future context slot) empty. Utterances are felicitous if the update obeys the felicity constraints in (14). In their model B&R also include two 'maintenance' operations: rejection of a move, i.e. rejecting a future context, and the elimination of a QUD once it has been solved, which requires popping that QUD from the stack.[14] The empty stack is notated by $\langle\rangle$.

(21) $c + \ulcorner \text{Clear} \urcorner = \langle cs_c, Q_c, \emptyset \rangle$ **Rejection**

(22) $c + \ulcorner \text{Pop} \urcorner = \langle cs_c, \text{pop}(Q_c), \mathscr{F}_c \rangle$ **QUD resolution**
Constraints:
a. $\mathscr{F}_c = \emptyset$ b. $Q_c \neq \langle\rangle$

The last relevant notion for our proposal in B&R is the notion of 'inquisitiveness'. A context is inquisitive if $top(Q)$ is not purely informative, i.e. if the context doesn't entail its answer:

(23) A local context l is non-inquisitive just in case $top(Q_l)$ is *purely informative* relative to cs_l (see (24)).

(24) **(Pure) informativity**
A set of propositions A is purely informative relative to a context set c iff
$\left|\left\{p \in D_{\langle st \rangle} \mid p \neq \emptyset \wedge \exists q \in A : p = q \cap c\right\}\right| = 1$
Paraphrase: There is exactly one $q \in A$ such that $q \cap c \neq \emptyset$

The definitions above result in a set of propositions being inquisitive iff there is not only one alternative viable in the context (i.e. if the set is not purely informative).

4. WhQs vs WhDecs: Interrogatives vs Declaratives

4.1. WhQs

The semantics of WhQs The compositional analysis provided here builds on analyses within the Hamblin/Rooth tradition. The keys for this analysis is that (i) questions denote sets of propositions and (ii) how those propositions are identified by linguistic cues.

In the Hamblin-semantics tradition declaratives denote singleton sets and interrogatives are sets of sets of possible worlds (sets of propositions). Alternative sets compose via pointwise function-argument application.[15] If the sets are singletons, composition behaves like standard

[14] B&R assume that when QUDs are not inquisitive (see (23) below), they pop automatically (this mechanism to clear non-inquisitve QUDs follows most directly Groenendijk, 1999).

[15] From Kratzer and Shimoyama (2002):

(i) Pointwise Function-Argument Application
If α_M is a branching node with daughters β and γ, and $[\![\beta]\!]^{g,c} \subseteq D_\sigma$ and $[\![\gamma]\!]^{g,c} \subseteq D_{\sigma,\tau}$,
then $[\![\alpha_M]\!]^{g,c} \underset{\text{def}}{=} \{a \in D_\tau | \exists b \exists c (b \in [\![\beta]\!]^{g,c} \wedge c \in [\![\gamma]\!]^{g,c} \wedge a = c(b))\}$

function-argument application. In the Hamblin-semantics literature following Kratzer and Shimoyama (2002) operators manipulating alternatives are dissociated from lexical items introducing them. The alternatives introduced in the composition by lexical elements are collected by operators, e.g. an '∃' operator providing existential force, as in the case of disjunction in declaratives (this operator returns a singleton set) or a 'Q' operator in the case of *wh*-interrogatives or interrogatives with disjunction (see Biezma and Rawlins, 2012 for alternative questions; this operator leaves the set of alternatives intact). Kratzer and Shimoyama's (2002) original definitions are in (25). A standard definition for *wh*-words is in (26). (Given that the discussion below will consider the link between utterances and discourse and that within the Roothian tradition this is mediated by focus meaning, I start differentiating between the ordinary meaning ($[\![\cdot]\!]^o$) and the focus meaning ($[\![\cdot]\!]^f$).[16])

(25) Where $[\![\alpha]\!]^o \subseteq D_{\langle\langle s,t\rangle,t\rangle}$ Kratzer and Shimoyama (2002)
 a. $[\![\exists\alpha]\!]^o = \{\lambda w.\exists p \in [\![\alpha]\!]^o : p(w) = 1\}$ (preliminary)
 b. $[\![Q\alpha]\!]^o = [\![\alpha]\!]^o$ (preliminary)

(26) $[\![wh\text{-}]\!]^o = D_\tau$ (where τ stands for the type of the given *wh*-word)

The alternatives generated by the *wh*-word enter into the composition via point-wise function-argument application. This system, as is, would provide the following denotation for WhQs:

(27) $[\![$**Where is the boyfriend?**$]\!]^o$ = $[\![[Q[$**the boyfriend is where**$]]]\!]^o$ =
 $[\![Q(\{$the boyfriend is at home; the boyfriend is camping,...$\})]\!]^o$ =
 $\{$the boyfriend is at home; the boyfriend is camping,...$\}$

The denotation of the interrogative in (27) is, hence, a set of propositions varying on the different locations where the boyfriend may be. Notice that the alternatives manipulated by the 'Q' operator are the set of alternatives generated by the *wh*-word, which does not mean that these are the only alternatives under discussion in the context of utterance. This is in particular relevant when understanding that *nowhere*, *nothing*, *nobody* etc, what I term 'empty-set' responses can be live-alternatives in the context of utterance, i.e., when understanding that *wh*-interrogatives do not (necessarily) trigger the so called 'existential' presupposition.[17] The status of this existential inference has been discussed in the literature (see e.g. Roberts, 1996; Abusch, 2009; Stalnaker, 2014; Biezma and Rawlins, 2017a). Abusch (2009) calls this inference the *some-alternative presupposition*, i.e. the presupposition that the disjunction of the set of propositions introduced lexically is true, and presents data showing that such inference can be cancelled and is contextually dependent.[18] Stalnaker, 2014 also argues that the existential

[16] In Rooth's framework, a sentence is associated with both an ordinary semantic value ($[\![\cdot]\!]^o$) and a focus semantic value $[\![\cdot]\!]^f$. The focus semantic value of an utterance is the set of alternatives obtained by substituting the focused element. (The English translation below is a shorthand for propositions.) Recall also that in Hamblin semantics, declaratives denote singleton sets:

(i) John eats [POTATOES]$_F$
 a. $[\![$John eats [POTATOES]$_F]\!]^o = \{$John eats potatoes$\}$.
 b. $[\![$John eats [POTATOES]$_F]\!]^f = \{$John eats potatoes; John eats cookies,...$\}$.

[17] See Roberts (1996) for discussion on the existential presupposition in QUDs.

[18] See Abusch (2009), ex. (16b) repeated below or Biezma and Rawlins (2017a) for additional examples:

(i) I've alienated my colleagues completely. Who will vote for me? Probably nobody.

inference is not a presupposition and claims that it is merely an entailment of the set of answers.

There is, hence, a difference between the 'semantic alternatives' (the alternatives introduced in the composition lexically) and the alternatives that are under consideration in the evaluation of the question, which may include additional alternatives inferred from the context. If we were to enforce that the semantic alternatives be the only alternatives under consideration, we would predict (counter the empirical observations) that all *wh*-questions trigger the existential presupposition. To explain this discrepancy, authors appeal to pragmatic mechanisms affecting the interpretation of questions. For example, Abusch (2009) argues that while a default process generates a presupposition from the set generated semantically (and hence we often take away that *wh*-interrogatives trigger such inference), this process does not take place "if the some-alternative presupposition is either inconsistent with context or made implausible by context."

One way to capture this division of labor between semantics and pragmatics in the interpretation of questions is to bridge them in the denotation. I agree with Stalanker's view that the existential presupposition in *wh*-questions (when it is present) is an entailment of the set of alternatives under consideration. The proposal below also assumes, that the semantics establishes what the question in discourse (QUD) is about but does not solely determine it (see Roberts, 1996).

In what follows I adopt and adjust Biezma and Rawlins's (2012) proposal for the 'Q' operator, which does just that (see also Biezma and Rawlins, 2017a for a fully fleshed out version). The system assumes that utterances provide conventionally information regarding where they are located in discourse (where discourse is a hierarchical order of moves). That is, an explicit discourse 'move' is a communication event tightly linked to a context of utterance and to a linguistic form. In what follows, given some move M, the context of utterance for that move at that point in discourse is notated c_M.[19]

(28) A move M's **Content** is defined by:
  a. If M is overt, $\text{Content}(M) = [\![\beta_M]\!]^o_{c_M}$ where β_M is the linguistic form uttered in move M and c_M is the context of utterance of M.
  b. Otherwise, $\text{Content}(M) \subseteq \mathscr{P}(\mathscr{W})$. ($\approx$ implicit moves are questions.)

(29) ALT_{c_M} is the set of propositional alternatives that are salient in the context of interpretation c for move M. (v1 preliminary)[20]

(30) Let M be a move such that $\text{Content}(M) = [\![\text{Q}[\alpha]]\!]^o_{c_M}$, where $[\![\alpha]\!]^o_{c_M} \subseteq D_{\langle\langle s,t\rangle,\, t\rangle}$
  $[\![\text{Q}[\alpha]]\!]^o_{c_M} = [\![\alpha]\!]^o_{C_M}$, defined only if
  a. $[\![\alpha]\!]^o_{c_M} \subseteq \text{ALT}_{c_M}$ or if $\text{ALT}_{c_M} = \emptyset$ b. $|\, [\![\alpha]\!]^o_{c_M} \cup \text{ALT}_{c_M} \,| > 1$

The 'Q' operator in (30) does not affect the semantic alternatives (as in (25b)) but imposes felicity conditions. The definedness conditions in the 'Q' operator, once we assume the utterance is made by a cooperative speaker, often translates into *informative presuppositions* in the sense of Stalnaker (1998) (presuppositions triggered in contexts where they are not satisfied but are satisfiable). Hence, the utterance of an interrogative provides information regarding what are

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[19] Biezma and Rawlins (2017a) build on Biezma and Rawlins (2012) and provide a fleshed out proposal within the QUD system (see e.g. Roberts, 1996). The formal details in Biezma and Rawlins (2017a) are not necessary for our discussion here. I present here a simplified version.
[20] The possible answers to the QUD dominating M.

the salient alternatives in discourse: if there were no salient alternatives present in the context (i.e. in a discourse initial situation, ALT$c_M = \emptyset$), we learn that $[\![\alpha]\!]^o_{c_M}$ are live alternatives (and accommodate it). If participants are conscious of the alternatives available, we are told to focus on a subset of them, $[\![\alpha]\!]^o_{c_M}$ (of course, in a scenario in which we know that there are alternatives available but it is not clear to participants which ones they are, we learn that $[\![\alpha]\!]^o_{c_M}$ are amongst the salient alternatives). The utterance of an interrogative presents alternatives and requests that the addressee choose between those alternatives and others inferred in context. What is key is that in (30) lexically introduced alternatives do not completely constrain the live alternatives. This was important in the interpretation of non-*wh*-questions in Biezma and Rawlins (2012, 2017a): the utterance of a polar question (e.g. *do you want pasta↑?*) presents an alternative (polar questions are singleton sets, $[\![\alpha]\!]^o_{c_M} = \{$the addressee wants pasta$\}$) and requests that the addressee choose between that alternative and other contextually salient alternatives that they must infer from the context (e.g. other edible options). In Biezma (2009); Biezma and Rawlins (2012), the difference between polar questions and alternative questions (*do you want pasta or fish↓?*, where '↓' stands for a final falling contour, e.g. H* L-L%) is that the final falling contour acts as a lexical marker indicating that the alternatives presented (e.g. that the addressee wants pasta and that the addressee wants fish), the content of the question, exhaustify logical space, i.e. that the alternatives introduced lexically are all the alternatives available in the context of utterance (ALT$_{c_M} = [\![\alpha]\!]^o_{c_M}$).[21] While Biezma and Rawlins (2012, 2017a) focus mostly on non-*wh*-questions, the aim is that this 'Q' operator be also the one in *wh*-questions and I make use of it here. In (31) I define the focus and ordinary value of *wh*-words, the latter containing only salient alternatives:

(31) a. $[\![wh\text{-}]\!]^f = D_\tau$ (where τ stands for the type of the given *wh*-word)
b. $[\![wh\text{-}]\!]^o = \{x : x \in [\![wh\text{-}]\!]^f \;\&\; x \text{ is contextually salient}\}$

(32) $[\![$Where is the boyfriend?$]\!]^o = [\![$[Q[the boyfriend is where]]$]\!]^o =$
$[\![$Q($\{p : p = \lambda w.$ the boyfriend is in x, for x a contextually salient location$\}$)$]\!]^o =$
$\{$the boyfriend is at home; the boyfriend is camping,...$\}$ defined only if
a. $\{p : p = \lambda w.$ the boyfriend is in x, for x a contextually salient location$\} \subseteq$ ALT$_{c_M}$ or ALT$_{c_M} = \emptyset$
b. $|\{p : p = \lambda w.$ boyfriend is in x, for x a context. salient location$\} \cup$ ALT$_{c_M}| > 1$

As in the case of polar questions, *wh*-interrogatives present alternatives and request that the addressee choose between those alternatives and other contextually salient inferred from the context. That is, alternatives introduced lexically do not completely determine the live alternatives under consideration and the burden of including (non-semantic) alternatives is in the pragmatics. This leaves room for the 'empty-set' alternative to be considered as a live alternative if it is salient in the context of utterance (i.e. if it is part of ALT$_{c_M}$). The some-proposition/existential inference is obtained when there are no salient alternatives other than the ones introduced lexically (the inference is, then, an entailment, as pointed out in Stalnaker, 2014). The question is what is the mechanism that allows us to take under consideration the empty-set alternative but not any other non-semantic alternative. The empty-set alternative needs to be included as a non-focus alternative (given (31) the semantic alternatives in *wh*-questions already include all possible *wh*-focus alternatives that are contextually salient), but the mechanism that allows us to

[21] In ftn. (22) I suggest that such type of constraint may also play a role in the difference between *wh*-words and indefinites in English.

include the empty-set alternative has to be principled to allow us to make the right predictions.

Recall that *wh*-questions, as non-*wh*-questions, ask the addressee to choose amongst alternatives that include both alternatives presented and inferred. Linguistically, focus-marking is what drives our inferences regarding what alternatives are under consideration (the live alternatives are a subset of the focus value of the utterance). The worry is how to control what alternatives can reasonably be let in pragmatically in ALT_{c_M} without them being a focus alternative. The suggestion I want to put forward is that, given that a question is a request to evaluate alternatives, it is reasonable to let in the possibility that none of the live focus alternatives is actually true. This is exactly what the empty-set answer is. In order to formalize this intuition we first identify the focus-alternatives of the utterance with the auxiliary definition in (33), and then constrain what the salient alternatives in the context of utterance can be taken to be, (34): either just the focus-alternatives or the focus alternatives plus the possibility that none of them is true. (34) acknowledges the role of focus in identifying alternatives while at the same time taking into account the logical possibility that none of the alternatives is true.

(33) Given a move M with linguistic expression α_M in a context c,
f-Content$(M) = \{p : p \neq \emptyset \wedge p \in [\![\alpha_M]\!]^f \wedge \exists q \in [\![\alpha_M]\!]^f : p = q \cap cs_c\}$
(Paraphrase: The non-empty focal alternatives that are live options relative to the context set in context c)

(34) ALT_{c_M} is the set of live alternatives considered upon acceptance of M: (final version)
a. $\mathrm{ALT}_{c_M} = f$-Content(M) or
b. $\mathrm{ALT}_{c_M} = f$-Content$(M) \cup \{\lambda w. \forall p \in f$-Content$(M), p(w) = 0\}$

One of the predictions is that the empty-set answer is more easily available in some contexts than in others (see also Abusch, 2009).

(35) a. Mother: To grow strong yo have to eat well. You can choose what you eat for lunch today. So, what do you want?
Kid: #I'm fine. I'm not hungry.
b. Host: I'm afraid I don't have much to offer you. What do you want? I got a celery stick and half an apple.
Guest: I'm fine, thank you.

The difference between (35a) and (35b) is in the pragmatics. In (35a) the mother establishes that the addressee has to choose one of the options and that s/he is not allowed to discard all the options offered (in *wh*-questions these are all the salient options). The kid's response can only be accepted if we understand that s/he is challenging the mother's assumptions (i.e. s/he is signalling presupposition failure). In (35b), it is understood that the addressee may choose not to eat anything and hence the empty-set response is fine without it indicating presupposition failure. It is harder to accept the empty-set answer in other circumstances:

(36) A: Where is the boyfriend?
B: ?#Nowhere.

The empty-set response is only possible if we undertand it as short for "nowhere I can think of" (while knowing that there must be other alternatives), or as implying that he is dead, in which case it is signaling presupposition failure (i.e. the boyfriend actually *isn't*, he's dead).

The dynamic update of WhQs The dynamic update in a context c is as follows:

(37) Let ϕ be the sentence *where is the boyfriend?*
  a. $c + \ulcorner\text{Question}(\phi)\urcorner = \langle cs_c, Q_c, l_c \oslash \ulcorner\phi\urcorner\rangle$
  b. $l_c \oslash \ulcorner\phi\urcorner = \langle cs_{l_c}, push(Q_{l_c}, [\![\phi]\!]^o)\rangle$
  c. Acceptance: $c_2 = \langle cs_{l_c}, Q'_c, \emptyset\rangle$

By uttering the interrogative the speaker proposes to update the context in such a way that the set of alternatives be placed on the top of the question stack (to become the immediate QUD in Roberts's terms). Accepting the proposal makes the proposed updated context (the projected context $\mathscr{F}_c$) the current context, and subsequent discourse moves are then geared towards answering the newly placed question (either by providing answers or by proposing new questions to answer it). As we will see below, the final result is similar to that of WhDecs.

4.2. WhDecs

The semantics of WhDecs The proposal in this paper is that WhDecs are declaratives containing a lexical item introducing alternatives (the *wh*-word). In the Hamblin system, lexically introduced alternatives in declaratives are collected by the '∃' operator. Adopting the operator in (25a) the denotation of the WhDec *the boyfriend is where?* is as in (38):

(38) $[\![\exists[\text{the boyfriend is where}]]\!]^o = \{\lambda w.\exists p \in [\![\text{the boyfriend is where}]\!]^o : p(w) = 1\}$

With WhDecs we face the same problem with the empty-set answer noted for WhQs. One solution is to again invoke ALT_{cM} as in (34). This is what the '∃' operator in (39) does.

(39) Let M be a move such that $\text{Content}(M) = [\![\exists[\alpha]]\!]^o_{cM}$, where $[\![\alpha]\!]^o_{cM} \subseteq D_{\langle\langle s,t\rangle,\,t\rangle}$
  $[\![\exists[\alpha]]\!]^o_{cM} = \{\lambda w.\exists p \in \text{ALT}_{cM} : p(w) = 1\}$
  defined only if $[\![\alpha]\!]^o_{cM} \subseteq \text{ALT}_{cM}$

The resulting semantics for our running WhDec example is as follows:

(40) Given the utterance of the WhDec *the boyfriend is where?*, M:
  $[\![\exists[\text{the boyfriend is where}]]\!]^o_{cM} = [\![\exists[\alpha]]\!]^o_{cM}$
  $[\![[\alpha]]\!]^o_{cM} = \{p : p = \lambda w.\text{ the boyfriend is in } x,\text{ for } x \text{ a contextually salient location}\}$
  $[\![\exists[\alpha]]\!]^o_{cM} = \{\lambda w.\exists p \in \text{ALT}_{cM} : p(w) = 1\}$, defined only if $[\![\alpha]\!]^o_{cM} \subseteq \text{ALT}_{cM}$.

The resulting semantics leaves room for the empty-set alternative to be relevant for the interpretation if it is a salient alternative in the context of utterance.[22]

[22] In this paper I do not address how utterances of WhDecs are different from utterances of declaratives containing indefinites and in particular so called epistemic indefinites (see Alonso-Ovalle and Menéndez-Benito, 2015 for a recent collection of papers on the topic). There are obvious relations between indefinites and question-*wh*-words as illustrated by the fact that in some languages such as e.g. Japanese and Tlingit they have the same (surface) form (see e.g. Kratzer and Shimoyama, 2002, Cable, 2010, Kotek, 2014 and references therein for discussion). WhDecs and utterances with indefinites are different. In particular, in utterances with indefinites the empty-set alternative is not a live alternative. Consider the contrast in A's continuations below:

(i) A: John hardly ever eats anything…
  a. #Today he ate something, probably nothing.
  b. Today he ate what? Probably nothing.

One way to account for this contrast could be to assume that indefinites require that the alternatives under consideration be the semantically generated alternatives alone (i.e., that $\text{ALT}_{cM} = P$), while that is not a constraint

Notice, however, that the semantics only establishes that there are different possibilities for the location of the boyfriend. Since this is a declarative, this is how the context set gets updated (information-wise, this is rather trivial). The semantics does not itself address the inquisitive flavor associated with WhDecs. The key to addressing this problem, I suggest, comes from our understanding of the dynamic update.

The dynamics of WhDecs The dynamics of WhDecs are different from the dynamics of WhQs. In the case of WhDecs we have a declarative and its update involves adding information to the common ground. Given that we are working within Hamblin semantics, where propositions are singleton sets, we need to adjust the definition of '$\oplus$' in (14). The definition in (41) is an amendment to (14a) where we merely extract the set of possible worlds within the set denoted by the (declarative) WhDec and then conjoin it with the *cs* in the update:

(41) Let Φ be a sentence s.t. $[\![\Phi]\!]^o$ is a singleton set containing $\varphi_{\langle s,t\rangle}$ (let us call this $\varphi_{\langle s,t\rangle}$ ContentProp(Φ))
$l \oplus \ulcorner \Phi \urcorner = \langle cs_l \cap \text{ContentProp}(\Phi), Q_l\rangle$
Felicity constraints:
a. cs_l is compatible with ContentProp(Φ). (assertability)
b. ContentProp(Φ) is relevant to $top(Q_l)$

The felicity constraints of assertions require that the content of WhDec be compatible the *cs* and that it be relevant to $top(Q_l)$. We do know from our discussion of the empirical data above, that WhDecs are linked in a special way to discourse. The next step is to establish what are the constraints on $top(Q_l)$ in a principled way. Given that WhDecs are declaratives, the constraints imposed by WhDecs should be similar to those imposed by other declaratives.

In the Roothian tradition, the relation between utterances and discourse is mediated by focus. Focus establishes an anaphoric relation with discourse that is cashed out by a congruence constraint (see Constant, 2014: pg. 89):

(42) Question-Answer congruence: An utterance U with F-marking answers a question containing ≥ 2 alternatives from the set $[\![U]\!]^f$.

This congruence constraint is derived in the Roothian tradition with the definition of the '$\sim$' operator. In (43) I provide a version of this operator based on Constant's (2014) rendition that works with Hamblin semantics.

(43) Roothian '$\sim$' adapted to Hamblin semantics
a. $[\![\sim \phi]\!]^o = [\![\phi]\!]^o$ b. $[\![\sim \phi]\!]^f = [\![\phi]\!]^o$
c. ... and presupposes that the context contain an antecedent C such that:
(i) $C \subseteq [\![\phi]\!]^f$ (ii). $|C| > 1$ (iii). $[\![\phi]\!]^o \subset C$

The main work of this operator is done by (c). According to (c), $\sim$ establishes that utterances with a given focus-structure presupposes a specific context of utterance: one in which there are

in *wh*-words. In a way, this is equivalent as saying that regular indefinites lead to closure effects similar to the closure operator in Zimmermann (2000); Biezma and Rawlins (2012): the alternatives under consideration are the semantically generated alternatives. This will leave unchanged claims made for indefinites in the literature and allows us to explain the interpretation of *wh*-words when met by an existential operator while keeping only one '$\exists$' operator and interpretation for *wh*-words. Presumably, differences between *wh*-words and *wh*-indefinites are also related to information structure and focus. I leave exploring these differences for future research.

alternatives under discussion that are also focus alternatives.[23] I put this at work below.

Following the semantics proposed above for *wh*-interrogatives, the focused element in WhDecs is the *wh*-word itself. This provides the focus meaning in (44) for our running example, where we find the constraints imposed by the '∃' operator and the presuppositions imposed by '∼':

(44) $[\![\exists[\sim\text{the boyfriend is where}_{\text{F}}]]\!]^{f} = \{\lambda w.\exists p \in \text{ALT}_{c_M} : p(w) = 1\}$
defined only if $\{p : p = \lambda w.$ the boyfriend is in x, for x a context. sal. location$\} \subseteq \text{ALT}_{c_M}$ and felicitous only if there is an antecedent in discourse C, s.t. $C \subseteq \{$the boyfriend is at home, the boyfriend is camping, $\ldots\}$, i.e. only if there is a question in discourse of the form *where is the boyfriend?* (namely, only if $top(Q_l)$ is (27)).

The system derives that WhDecs are only felicitous if there is a question in discourse of the form of their WhQ-counterparts. We turn now to the dynamic update of WhDecs, which will derive their inquisitive effect. To that end, we start by looking at regular declaratives and show that WhDecs behave alike.

4.2.1. The dynamic update of declaratives

Let us assume that Detective Sykes utters (45), whose focus meaning is in (46):

(45) Det. Sykes: The boyfriend is in [JOSHUA TREE]$_{\text{F}}$

(46) $[\![(45)]\!]^{f} = \{$The boyfriend is in Joshua tree$\}$
felicitous only if there is a question in discourse of the form *where is the boyfriend?*, one of whose possible answers is that the boyfriend is in Joshua Tree.

The utterance of (45) hence triggers a presupposition that $top(Q_l)$ is a question of the form *where is the boyfriend?* As laid out above, the dynamic update can only take place once this presupposition is accommodated (if it is not the case that the question has been explicitly accepted and become $top(Q_l)$ already). Once this is done, we can proceed with the dynamic update of the declarative.

The declarative proposes that the *cs* in the context *c* with the accommodated question be updated with the information that the boyfriend is in Joshua Tree. When the (declarative) move is accepted, $top(Q'_c)$ is resolved and hence the question is popped ($pop(Q'_c)$). The resulting question stack is then as it was before the (declarative) move was made, (47b) ($Q_{c_2} = Q_c$).

(47) Let $c = \langle cs, Q, \emptyset\rangle$ be the initial context:
a. $c + \ulcorner Assert(\text{The boyfriend is in [Joshua Tree]}_{\text{F}})\urcorner$
(i) Accommodate that the local context is $\langle cs_c, Q'_c\rangle = l'_c$ (Focus anaphora)
s.t. $Q'_c = push(Q_c, [\![\text{where is the boyfriend?}]\!]^{o})$, i.e.
$top(Q'_c) = [\![\text{where is the boyfriend?}]\!]^{o}$
(ii) Propose the update of *cs* (with the answer) (Assertion)
$\langle cs_c, Q'_c, l_{c'} \oplus \ulcorner\text{The boyfriend is in [Joshua Tree]}_{\text{F}}\urcorner\rangle$
$l_{c'} \oplus \ulcorner\text{The boyfriend is in [Joshua Tree]}_{\text{F}}\urcorner =$
$\langle cs_c \cap \text{contentProp(The boyfriend is in [Joshua Tree]}_{\text{F}}), Q'_c\rangle$

[23]Notice Rooth's view on focus does not establish that one of those alternatives is true. That is, Rooth doesn't assume that focus triggers an existential presupposition.

b. Acceptance: Accept the proposed future context and $pop(Q'_c)$:
$$c_2 = \langle cs_c \cap \text{contentProp(The boyfriend is in [Joshua Tree]}_{\text{F}}), Q'_c, \emptyset\rangle$$

With regular declaratives the final result of the update only allows us to see the change in *cs*. There is no trace left of the intermediate accommodation of the question presupposed via focus anaphora. At the end of the update the accommodated question is popped. In the case of WhDecs, since they are 'vacuous' content-wise, *cs* will remain as it was and the accommodated question won't be popped.

4.2.2. The dynamic update of WhDecs

The same presupposition-accommodation process that we observed for regular declaratives (accommodation of $top(Q_l)$) takes place with WhDecs.[24] However, the final result is different. The difference is that, given that WhDecs are a trivial update of *cs*, the question on $top(Q_l)$ is not resolved upon acceptance and, hence, it is not popped:

(48) Let $c = \langle cs, Q, \emptyset\rangle$ be the initial context and $WhDec$ the WhDec *the boyfriend is where?*
 a. $c + \ulcorner\text{Assert}(WhDec)\urcorner = \langle cs_c, Q_c, l_c \oplus \ulcorner WhDec\urcorner\rangle$
  (i) Accommodate that the local context is $\langle cs_c, Q'_c\rangle = l_{c'}$ (Focus anaphora) s.t. $Q'_c = push(Q_c,\ [\![\text{where is the boyfriend?}]\!]^o)$, i.e. $top(Q'_c) = [\![\text{where is the boyfriend?}]\!]^o$
  (ii) Propose the update of *cs*: (Assertion)
$$\langle cs_c, Q'_c, l_{c'} \oplus \ulcorner WhDec\urcorner\rangle$$
$$l_{c'} \oplus \ulcorner WhDec\urcorner = \langle cs_c \cap \text{ContentProp}(WhDec), Q'_c\rangle$$
 b. Acceptance: Accept the proposed context
  $c_2 = \langle cs_c, Q'_c, \emptyset\rangle$ (Trivial update of *cs*)

At the end, the utterance has not changed *cs*, given that WhDecs are trivial regarding its content. However, Q_c has been changed: $top(Q'_c)$ is now the newly accommodated question, i.e. a question of the form *where is the boyfriend?* The resulting update is indeed the same update we achieved with the utterance and acceptance of the WhQ *where is the boyfriend?* (see (37)). The result predicts that subsequent responses to WhDecs are geared to addressing the newly accepted $top(Q'_c)$, i.e. they are predicted to be similar to responses following the acceptance of the WhQ counterpart of the WhDec. This is what creates the mirage that WhDecs are questions.

To sum up, by taking into account the dynamic update of WhDecs as declaratives, we have been able to derive why they behave like questions. The final dynamic update is the same, but we arrive at it through different routes. In §5 I argue that this difference in the process is what makes the difference in the pragmatics.

5. Explaining the data

Given that WhDecs presuppose that there is a question that needs to be answered, felicity is dictated by the willingness of the addressee to accept that she is committed to pursuing this question. She never has the chance to openly accept it. The speaker uttering the WhDec

[24]Notice that WhDecs are not felicitous if the WhQ counterpart is spelled out explicitly.

presupposes that the question is already accepted and hence (if this is an informative presupposition) 'imposes' it on the addressee. This is why WhDecs are only possible if the power dynamics are right: the speaker has to have 'power' over the addressee or at least be an equal (see (8) and (9) above).

The same accounts for the impossibility of WhDecs out of the blue: participants have a hard time accepting why they should go along with the pretense that they have already accepted to pursue an inquiry that is not immediately relevant in the discourse. Put differently, they have problems accepting that there are particular salient alternatives that are under discussion, e.g., regarding the location of a place to buy an Italian newspaper (see (7)). This is also what we observe in out of the blue declaratives:

(49) Graduate students are working in their office. A, also a graduate student, comes in:
A_1:#Hey! My uncle makes cheese in Vermont.
A_2: Hey! There are free bagels in the common room.

The infelicity of A_1's utterance results from the difficulty of accommodating that that piece of information is relevant. In the system adopted in this paper, this means that there is a difficulty to understand that the conveyed proposition is a amongst the relevant alternatives to be evaluated (the context assumes broad focus and those alternatives form an issue that could be paraphrased with the linguistic counterpart *what happened?*). This is the same as to say that it is hard to accommodate the question presupposed by the speaker (since questions are no more than sets of propositions). It is certainly less problematic to accept that there being free bagels is a relevant alternative (the question the speaker is presupposing, i.e. what she considers to be relevant alternatives under discussion, is easier to accommodate).

The present proposal also explains the data regarding sequences of questions:

(11) [Lt. Provenza in the same preceding context to the WhDec in (5).]
a. #Ok, where is the boyfriend? The parents are where?
b. ?#Ok, and the boyfriend is where? Where are the parents?
c. Ok, and the boyfriend is where? The parents are where?
d. Ok, and where is the boyfriend? Where are the parents?

(11a) is infelicitous because accepting the WhQ places it on the top of the *Q*-stack, but the WhDec that follows triggers the presupposition that a different question is on the top of the *Q*-stack, resulting in contradiction. The oddity of (11b) is the result of the mix of strategies: the speaker asks the addressee to presuppose that a question is to be answered just to propose to add another. The speaker could have just uttered the WhQ upfront. Sequences of two WhDecs or two WhQs that are taken to be part of the sams strategy to answer a higher question are fine: in (11c) the speaker 'tells' the addressee what are the questions that need to be answered next while WhQs propose to pursue the two questions spelled out.

6. Going forward: The role of intonation

In this paper I have argued that, taken seriously, the dynamic update of utterances helps us explain pragmatic inferences without ad-hoc stipulations in the semantics. For reasons of space, I cannot address here how the system presented in this paper can be extended to RisDecs (see e.g. Gunlogson, 2003; Malamud and Stephenson, 2015; Westera, 2018 for recent work on the matter). (The reader is referred to Biezma, 2019 for a sketch of how this may work.)

Notice that the proposal put forward in this paper derives the interpretation of WhDecs without assigning the final intonational contour any role to play. As a matter of fact, WhDecs are possible also with a final fall (see ftn. 5 above), and this does not affect their inquisitivity. This may appear puzzling when comparing WhDecs with RisDecs, in which the final rising contour is the only marking that distinguishes them from plain declaratives and brings about inquisitivity. One could try to understand this by noting that the semantics and pragmatics of WhDecs already bring about the inquisitive interpretation, freeing in this way the use of the final contour to bring about additional shades to the interpretation (such as "curtness", see Bartels, 1999). This perspective could possibly generalize to provide an alternative way of looking at the role of final contours across other constructions. The contrast between final rising and falling is also found within WhQs (see Hedberg et al., 2010 for discussion on their interpretations), and we have already seen above that within non-*wh*-interrogatives, the final contour serves to mark a contrast between polar and alternative questions regarding exhaustivity. The picture that emerges is one where the contrast between final raising and final falling contour has merely a markedness function that results in different effects within particular realms.

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As if s[1]

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Abstract. We provide an event semantic analysis of *as if*-phrases in manner reports and other modification uses on which these adjuncts contribute *hypothetical comparative* properties of eventualities. When combined with the dynamic verb *dance*, for instance, an *as if*-phrase expresses that the reported dancing event resembles in some relevant respect its counterparts in the most normal worlds described by the clause embedded under *as if*. Towards the end of the paper, we extend our analysis to *as if*-complements of copy raising verbs in perceptual resemblance reports.

Keywords: Event semantics, conditionals, manner reports, perception verbs, copy raising.

1. Introduction

This paper is an excerpt from a larger project in which we develop a compositional semantics for a range of *as if* constructions in English and explain their core pragmatic effects. While there has been theoretical and empirical work on the distribution and historical development of *as if* (Bender and Flickinger, 1999; Huddleston and Pullum, 2002; López-Couso and Méndez-Naya, 2012; Brook, 2014; Brinton, 2014), the syntax and semantics of perceptual verbs that take *as if*-complements (Postal, 1974; Potsdam and Runner, 2001; Asudeh, 2002, 2004; Landau, 2011; Asudeh and Toivonen, 2012; see also Breckenridge, 2007, 2018; Glüer, 2017 on *looks* reports), sarcastic uses of *as if* (Camp and Hawthorne, 2008; Camp, 2012), and the semantics of analogous "hypothetical comparative" constructions in other languages (see Bücking, 2017 on German *wei wenn* ('how if')), there has not to our knowledge been an extensive study with *as if* playing a starring role at the semantics-pragmatics interface. Part of the challenge with such a study is that *as if* is extremely productive, appearing in a range of syntactic environments, and each of its different uses raises its own interpretive puzzles.

Four core uses are illustrated in (1)-(4):

(1) *Manner use:* Pedro danced as if he {was} possessed by demons.

(2) *Perceptual resemblance report:* It tastes as if there were an angel peeing on my tongue. (Dutch compliment to the chef)

(3) *Root sarcastic use:* (Opening inbox) As if I have time to answer all these emails!

(4) *Clueless use:* (Gross guy makes an advance) Cher: Ugh, as if!

In this paper, we focus mainly on manner reports like (1) and related modification uses. It might seem that a satisfactory analysis of such examples shouldn't be too hard to come by. After all, there is already a great deal of work both on *if*-conditionals (some classics: Stalnaker, 1968, 1975; Lewis, 1973, 1975; Heim, 1983; Veltman, 1985; Kratzer, 1986) and on various similarity

[1]For helpful discussion and comments, we would like to thank María Biezma, Lucas Champollion, Alexander Göbel, Simon Goldstein, Michael Johnson, Kyle Rawlins, Rachel Rudolph, Simon Wimmer, the reviewers for *Sinn und Bedeutung 23*, and audiences at SuB 23, Hong Kong University, and the New York Philosophy of Language Workshop.

constructions in English and other languages (for recent work, see Alrenga, 2010 on *like*; Rett, 2013 on similatives; Umbach and Gust, 2014 on German *so* ('such'/'like this'), and the cross-linguistic studies on similatives and equatives in Treis and Vanhove, 2017). However, we argue that matters aren't so simple. In §2, we offer strong syntactic and semantic evidence that *as if* is an idiomatic compound, and we should therefore be wary of trying to analyze *as if*-phrases by just mashing together our best accounts of regular *if*-clauses and the ordinary preposition *as* (cf. Bücking, 2017). We also show that there are tempting ways to draw connections to prior research—such as building on Lewis's (1973) influential analysis of counterfactuals in terms of comparative similarity—that lead to trouble.

In §3, we develop a detailed analysis of the manner report (1). Roughly, we propose that (1) conveys that Pedro's past dancing resembles in respect of its manner—this is the *as* part—his dancing in scenarios in which he was possessed by demons, which is the *if* part. Formally, this is implemented within an event semantic framework (building on Davidson, 1967; Parsons, 1990; Landman, 2000; Beck and von Stechow, 2015, among others), where *as if*-phrases express *hypothetical comparative* properties of eventualities. More specifically, we take an *as if*-phrase to express a property that holds of an eventuality *e* when it resembles in some relevant respect (manner, in the case of (1)) each of its counterparts in the most *stereotypical* worlds described by the clause embedded under *as if* (and in which a counterpart of *e* exists). After motivating the different components of our analysis, we show how it can be imported into the kind of clausal architecture developed in Beck and von Stechow (2015) to give a fully compositional treatment of (1) and related examples.

Though we do not have space in this paper to discuss other uses of *as if* in depth, we conclude in §4 by briefly discussing how our analysis of *as if*-adjuncts in manner reports can be carried over to *as if*-complements of perception verbs in perceptual resemblance reports such as (2).

2. *As if* vs. *As...would...if*

It's tempting to think that *as if*-phrases are constructed from a regular *if*-clause headed by regular *as*, and that the meaning of the full phrase is then compositionally determined from the meaning of these parts (Bücking, 2017, for instance, offers a fully compositional treatment of German *wie wenn* ('how if')). Note that it is possible to insert material between *as* and *if* in many of the above examples without any apparent change in meaning, so *as if* doesn't seem to be particularly special:

(5) Pedro danced *as he would if* he was possessed by demons.

(6) Kiss me *as you would if* it were the last time.

However, there is strong evidence that *as if* is an idiomatic compound, in both a syntactic and semantic sense, that cannot be cleanly separated into distinct comparative and hypothetical components.

First, as Huddleston and Pullum (2002) observe, the kind of meaning-preserving intervention exhibited in (5) and (6) is not always possible:[2]

[2]This intervention with *would* is not possible with root sarcastic and *Clueless* uses:

(i) *As it would be if I have time to answer all these emails!

(ii) *As it would be if!

(7) #Don't attack a mouth as *you would* (attack a mouth) if you're dipping a mop into a slop-bucket!

Moreover, *as if* doesn't accept the intervening modifiers *only* or *even*—unlike *as...would...if* constructions which can be modified with either expression (von Fintel, 1994). In this respect *as if* patterns like *what if* (Bledin and Rawlins, 2016):

(8) The Dalai Lama acted {*as/as he would} {only/even} if he were angry.

(9) *What {only/even} if Napoleon had won at Waterloo?

Likewise, *as if* and *as...would...if* pattern differently with respect to the possibility of intervening with adverbs of quantification such as *always*, *usually*, or *never* (Lewis, 1975):

(10) *Ben is cycling as {always/usually/never} if he was drunk.

(11) Ben is cycling as he {always/usually/never} would if he was drunk. (Bücking, 2017)

We take these contrasting data to provide some preliminary support for the claim that *as if* is a fixed idiom chunk.

Moving from the externals of *if* to *if* itself, the first thing to observe is that one cannot typically replace the *if* in *as if* with wh-items. While *as when* constructions are possible, *as when* has a far more limited distribution than *as if*:

(12) Then it was quiet in a way he did not like either, as when everyone in class watched him for an answer. (COCA)[3]

(13) ??It's as when we still had landlines.

(14) *It's as {who/why/where/how}...

Moreover, one cannot replace the *if*-clause with a wh-clause to form an unconditional adjunct (Rawlins, 2008, 2013b) and one cannot substitute other complementizers like *if and when*, though such substitutions are possible in the filled out *as...would...if* constructions:

(15) Alfonso nodded {*as/as he would} whether or not he heard the question.

(16) Beggar So fought {*as/as he would} if and when drunk.

The internals of *as if*-clauses also differ from the internals of standard *if*-clauses in various respects. Huddleston and Pullum (2002) observe that *if* cannot be repeated in coordination within *as if*-phrases (but such coordination is possible within *as...would...if*):

(17) Annie was treated by the king {*as/as she would have been} if she were a noblewoman or if she were a commoner.

Finally, *as if* differs from *as...would...if* with respect to NPI licensing. While *as...would...if* resembles ordinary *if* in licensing weak NPIs like *anyone* and *ever*, non-root *as if* doesn't license such NPIs (or at least is a far less hospital environment for weak NPIs):

(18) She took a bow as she would if {someone/anyone} was in the theater watching her perform.

[3]Corpus of Contemporary American English, available online at `http://corpus.byu.edu/coca/`

(19) She took a bow as if {someone/*anyone} was in the theater watching her perform.

(20) John smells as he would if he ever got sprayed by a skunk.

(21) *John smells as if he ever got sprayed by a skunk.

On the other hand, as Camp and Hawthorne (2008) and Camp (2012) observe, sarcastic *as ifs* license NPI *any* and *ever*, in which respect they pattern like sarcastic *like*:

(22) {As if/Like} my son will ever leave home and get a job!

(23) A: Who won Eurovision?
B: {As if/Like} anybody cares!

Taken together, the above data suggest that while *as...would...if*-phrases are compositionally generated from regular *if*-clauses, *as if* is semantically and syntactically idiomatic. Perhaps at least some of the differences between *as if* and *as...would...if* can be explained away by those seeking a non-idiomatic treatment of *as if* in terms of regular *as* and *if*, but there would be a lot of explaining to do and so we don't pursue such a treatment in this paper.

That said, we do not mean to argue that *as if* is totally disconnected from regular *as* and *if*. On one hand, *as if* is still *iffy* in the sense that many of the characteristic morphosyntactic and inferential features of regular *if*-clauses carry over to *as if*-clauses as well. For instance, like regular *if*-clauses, *as if*-clauses generate nonveridical contexts in that sentences containing them do not entail the TP-complement of *as if* (as discussed, *as if*-phrases are in many cases used to convey that these embedded TPs are false):

(24) Oswald {is acting/looks} as if he didn't shoot Kennedy.
$\not\rightsquigarrow$ Oswald didn't shoot Kennedy.

One can use the subjunctive mood/fake past (Iatridou, 2000; Schulz, 2014) to signal counterfactuality:

(25) Pedro danced as if he were {possessed/Michael Jackson}.

(26) He's behaving as if he was a Neanderthal.

There are also analogs in the case of *as if* to other distinctive inferential patterns observed for indicative and subjunctive *if*-conditionals. We see apparent failures of *strengthening of the antecedent* (SA) (Goodman, 1947; Lewis, 1973):

(27) Messi is playing as if it is the Champions League final.
$\not\rightsquigarrow$ Messi is playing as if it is the Champions League final and Barcelona is already five goals ahead.

Furthermore, *as if*-clauses that embed disjunctions give rise to the inferences that motivate the principle of *simplification of disjunctive antecedents* (SDA) for *if*-conditionals (Nute, 1975; Ellis et al., 1977; Starr, 2014; Willer, 2015; Ciardelli, 2016; Lassiter, 2018):

(28) It smells as if someone is smoking cannabis or there is a skunk nearby.
$\rightsquigarrow$ It smells as if someone is smoking cannabis.
$\rightsquigarrow$ It smells as if there is a skunk nearby.

And so on.[4] The *iffy* nature of *as if* can also be seen, of course, from many uses that intuitively require us to consider scenarios in which the *as if*-complement holds.

On the other hand, *as if* is preposition-like in its externals, taking many of the same pre-modifiers as ordinary *as* and other prepositions, such as the adverbs *exactly*, *almost*, and *quite*:

(29) Put someone on a virtual roller coaster and their mind and body will react exactly as if they're on the real thing. (COCA)

(30) That sounded very businesslike, almost as if I knew what I was doing. (COCA)

(31) He sat there still fresh-faced and smiling, looking about him quite as if he saw nothing that I was seeing. (COCA)

Moreover, *as if* is *as-y* in the intuitive sense that many *as if*-sentences do seem to involve similarity comparisons. Presumably, someone who utters (30) is comparing how a previous speech act sounded to how it would sound if uttered when she knew what she was doing. Going forward, then, we pursue an analysis of *as if* that needn't involve the fusion of regular *as* and *if*, but we nevertheless take it to be an important desideratum of our semantics that it remain *as-y* and *iffy* in the sense that it has clear conditional and comparative components.

3. A Hypothetical Comparative Semantics

We first pursue an analysis of our lead-off manner use (1), repeated below as (32):

(32) Pedro danced as if he was possessed by demons.

Taking the *as* and *if* in *as if* seriously, our rough proposal is that (32) conveys that Pedro's dancing in the actual world resembles his dancing in possible situations where he was possessed by demons—that is, he danced wildly/crazily. The intuitive idea that *as if*-phrases can fix some relevant feature of an actual event via a comparison to events in other possible worlds is an old one—as Bücking (2017) reports, this idea (applied to German hypothetical comparative clauses) goes back at least to Kasper (1987). But, of course, the devil is in the details. And, as we will argue, there are some tempting ways to fill in the details that lead to bad results.

3.1. Refining the analysis

We work in the framework of event semantics (Davidson, 1967; Parsons, 1990; Landman, 2000; among many others). First, some points about our background ontology: following Bach (1981), we assume the existence of a domain of eventualities, where "eventuality" is a cover term for both events and states.[5] Furthermore, like Schaffer (2005), Beck and von Stechow (2015), and others, but unlike Hacquard (2006), we assume that eventualities occur in only a single world—they are world-bound. To identify "similar" eventualities across possi-

[4] The status of both SA and SDA for indicative and subjunctive conditionals is highly controversial. Our point is not that SA/SDA are invalid/valid and that the corresponding principles for *as if*-sentences are also invalid/valid, but only that we witness similar kinds of apparent failures of antecedent strengthening in both cases, and we can intuitively draw simplification inferences from both *if*-conditionals with disjunctive antecedents and *as if*-clauses with disjunctive complements in a broad range of cases.

[5] We use the variable e to range over events and the class of eventualities as a whole. Later in the paper when we have states specifically in mind, we use s to range over states only.

ble worlds, we help ourselves to Lewis' (1968) *counterpart theory* applied to eventualities and introduce the following transworld relation (see Schaffer, 2005 for a similar proposal):[6]

(33) **Counterpart relation between eventualities**
$C(e)(e')$ iff e' is a counterpart of e.

We assume the general things that Lewis says about counterparthood, such as that the relation C is reflexive—every eventuality is a counterpart of itself—but this relation needn't be symmetric or transitive. Also, while eventualities often have unique counterparts in other worlds, they might have multiple counterparts or none at all.

Stated in terms of counterparts, a more refined version of our proposal is that (32) conveys that there was an event e of Pedro's dancing that resembles its counterparts in possible worlds in which Pedro was demonically possessed. Like Lewis, we acknowledge that the relation C is "problematic in the way all relations of similarity are: it is the resultant of similarities and dissimilarities in a multitude of respects, weighted by the importances of the various respects and by the degrees of the similarities" (Lewis, 1968, p. 115). In fact, our counterpart relation between eventualities is admittedly more problematic than Lewis's original relation between individuals, as eventualities are more complex entities than individuals. But, like Lewis (1968), we won't go into more fine-grained details about C here. We do want to insist, however, that the notion of counterparthood remain fairly flexible in order to handle examples like the following:

(34) Pedro danced as if he was jumping rope.

On our proposal, the relevant counterparts to Pedro's dancing that enter into the evaluation of (34) aren't dancing events themselves but rather events of jumping rope. In general, to be a counterpart of e (i.e., a most similar event to e in a world), it can be enough to have (roughly) the same time and location as e and involve some of the same participants (or their counterparts).

Now, when evaluating sentences like (32), not just any eventuality counterparts should be taken into account. Presumably, there are possible worlds in which Pedro was possessed yet danced in a calm and sedate manner. We want to screen these worlds off and focus on only those in which a demonically possessed Pedro danced wildly. To whittle down the set of counterparts picked out by *as if* in this way, we might turn to Lewis again and adopt the *similarity relations* between possible worlds familiar from his classic work on counterfactuals (Lewis, 1973, 1979). The proposal would be that (32) conveys that there is an event e of Pedro's dancing which resembles its counterparts in the *most similar* worlds (to the actual world) in which Pedro was possessed by demons—see Bücking (2017) for a proposal about German hypothetical comparative clauses (HCCs) with "counterfactual readings" along these lines.[7]

[6] Lewis (1968) himself takes events to be transworld—he identifies events with classes of spatio-temporal regions that can span multiple worlds. While our counterpart-theoretic treatment of events is inspired by Lewis's work on modality, any conceptual errors associated with (33) are our own.

[7] The core semantics for *as if* that we are busy developing in this section is similar to Bücking's analysis of German HCCs, which was brought to our attention by a reviewer for *Sinn und Bedeutung 23* after we had already worked out the main ideas in this paper. However, there are some important differences between our account of English *as if*-phrases and Bücking's account of German HCCs. First, Bücking pursues a fully compositional treatment of *wie wenn* (the star of his paper) while we treat *as if* as a semantic unit (Bücking acknowledges that German *als*-HCCs headed by *als wenn*/*als ob*/*als wäre* ('as if'/'as whether'/'as were') exhibit syntactic and semantic idiosyncrasies, but he doesn't analyze these constructions in depth). Second, we are about to argue that *as if* selects for stereotypicality or normalcy relations while Bücking argues that German *als*-phrases with a

However, working with comparative similarity leads to trouble when faced with "contrary-to-expectation" sentences like (35) (the reason for this label will become clear shortly), as this form of analysis incorrectly predicts that sentences such as the following will sound terrible:[8]

(35) Melania is angry but she's not acting as if she's angry.

If the left conjunct of (35) holds, then—assuming that similarity orderings are *centered* in the sense that a world is always more similar to itself than any other world is—the most similar world to the evaluation world in which Melania is angry is just this evaluation world itself. On the similarity-based version of our analysis of *as if*, the right conjunct then turns on whether Melania's behavior *doesn't* resemble her behavior.

Intuitively, a speaker who utters (35) is saying that Melania is angry but she isn't acting as one might expect her to act when she's angry—she isn't yelling, flailing her arms around, and so forth. To capture this interpretation, we propose that *as if*-phrases select for *stereotypical* or *normalcy* orderings over logical space that represent what speakers consider to be normally the case (one might take these orderings to be induced by Kratzerian 1981 "ordering sources"; see also Asher and Morreau, 1991; Veltman, 1996; Pelletier and Asher, 1997 for related proposals):

(36) **Stereotypicality relation between worlds**
$v \leq_w u$ iff v is at least as typical as u from the perspective of w.

For ease of exposition, we make a version of the "Limit Assumption" (Lewis, 1973; Stalnaker, 1980) and assume that for every stereotypicality relation $\leq_w$ and non-empty proposition $p \subseteq \mathscr{W}$, there is some p-world that is at least as normal as all other p-worlds. We can then refine our proposal further and say that (32) conveys that the event e of Pedro's dancing resembles its counterparts in the *most typical* worlds in which Pedro was possessed by demons. To its credit, this stereotypicality-based analysis allows for contrary-to-expectation sentences be fine, as the world of evaluation needn't be the most stereotypical world by its own standards—our expectations can be disappointed in oh so many ways.

Of course, an eventuality e will resemble its counterparts in many boring respects. Presumably, the counterparts of Pedro's dancing in the most stereotypical worlds in which he was possessed all have roughly the same temporal trace, for instance. But it's the *manner* of these events that we're interested in here: (32) describes the manner of Pedro's dancing as being like the manner of its counterparts in the most normal Pedro-possessed-by-demons worlds. Generalizing from this example, it is tempting to analyze *as if* as effecting a manner comparison between an eventuality and certain of its counterparts under the scenario described by the embedded clause.

However, this would be another mistake, leading to an account that is overly restricted. In addition to manner uses, *as if*-adjuncts can be used to convey non-manner features of the matrix eventualities contributed by the verb phrases they modify, such as their location (37), and the (potential) cause or reason for their occurrence (38):

verb form in the counterfactual subjunctive should be given a Lewisian similarity-based analysis. Third, we aim to account for a broader range of *as if* data including perceptual resemblance reports (Bücking doesn't analyze similar constructions). In addition, there are numerous differences between our full semantic implementation in §3.2 and Bücking's account—we offer an explicit treatment of tense while Bücking does not, Bücking posits an ontology including both events and situations while we work with only events, and so on—but these are less central to the analysis of *as if*.

[8]Breckenridge (2007) rejects a similarity-based account of *looks as if* reports on the basis of such examples.

(37) Context: The king's policy is to meet nobles in his throne room and commoners in the hall. Occasionally he makes exceptions.

Though Annie was a mere commoner, the king met with her as if she were nobility.
$\rightsquigarrow$ The king met with Annie in the throne room.

(38) As if in response to the tough declarations from Hollande on Saturday, the Islamic State moments later asserted responsibility for the attacks. (COCA)

The moral from such non-manner reports is that we shouldn't lexically associate *as if* with manner comparisons. To allow for the required variation, we parametrize out the dimension and nature of comparison and evaluate *as if* sentences relative to a resemblance relation, which we take to be reflexive and symmetric but not necessarily transitive:

(39) **Resemblance relation between eventualities**
$r(e)(e')$ iff e' resembles e.

While r might relate eventualities based on respects of manner, it might also compare them based on other criteria, such as their means, locations, and so forth. Moreover, even once we've fixed on a manner comparison in the case of (32), there is the further question of how close the manner or style of a counterpart of Pedro's dancing needs to be in these or those respects to the manner of his actual dancing to count as resembling it. We assume that along any dimension (or dimensions) of comparison, r also encodes how 'close' eventualities need to be in the relevant respect (or respects) to count as resembling.

While we treat the resemblance relation r as a contextually supplied primitive, one could make this relation more transparent by deriving it from a basic similarity relation between points in one of Umbach and Gust's (2014) multi-dimensional "attribute spaces" (or Gärdenfors's 2000 "conceptual spaces").[9] Generalizing the measure functions found in degree-based accounts of gradable adjectives like *hot* and *tall*, which are taken to map entities to points in temperature scales, height scales, and so on (Kennedy, 1999), Umbach & Gust map entities to points in an attribute space and then count two entities as similar when their corresponding points in this space are similar. Adapting this approach for present purposes, one could introduce a generalized measure function μ mapping eventualities into a multi-dimensional attribute space and then let $r(e)(e')$ iff $\mu(e')$ is sufficiently close to $\mu(e)$ along the relevant dimension of the attribute space.[10]

Summing up, we are proposing that (32) reports that there was an event e of Pedro's dancing that r-resembles its counterparts (determined by C) in the most stereotypical possible worlds in which he was possessed (according to $\leq_{\omega(e)}$, where $\omega(e)$ is the world in which e occurs, which we call its "modal trace"). To turn this proposal into a formal analysis, we interpret sentences through a function $[\![\cdot]\!]^{c,g}$ relativized to a context of use c and an assignment function g (for evaluating pronouns), and we assume that each context c determines a counterpart relation C_c, a function $\leq_c$ mapping each world $w \in \mathscr{W}$ to a stereotypicality relation $\leq_{c,w}$, and a resemblance relation r_c. Using the first two parameters, we define a *selection function* f_c that takes an

[9]We are grateful to Bücking (2017) for bringing Umbach & Gust's research on similarity demonstratives (German *so*) to our attention.
[10]With generalized measure functions in place, one can also look to off-the-shelf accounts of degree modification in gradable adjectives to handle examples like (30) and (31). Thanks to Rachel Rudolph for helpful discussion.

eventuality e and proposition p as arguments and returns the counterparts of e in all the most normal p-worlds in which a counterpart of e even exists:

(40) $e' \in f_c(e)(p) \leftrightarrow C_c(e)(e') \wedge p(\omega(e')) \wedge$
$\forall w[(p(w) \wedge \exists e''[\omega(e'') = w \wedge C_c(e)(e'')]) \rightarrow \omega(e') \leq_{c,\omega(e)} w]]$

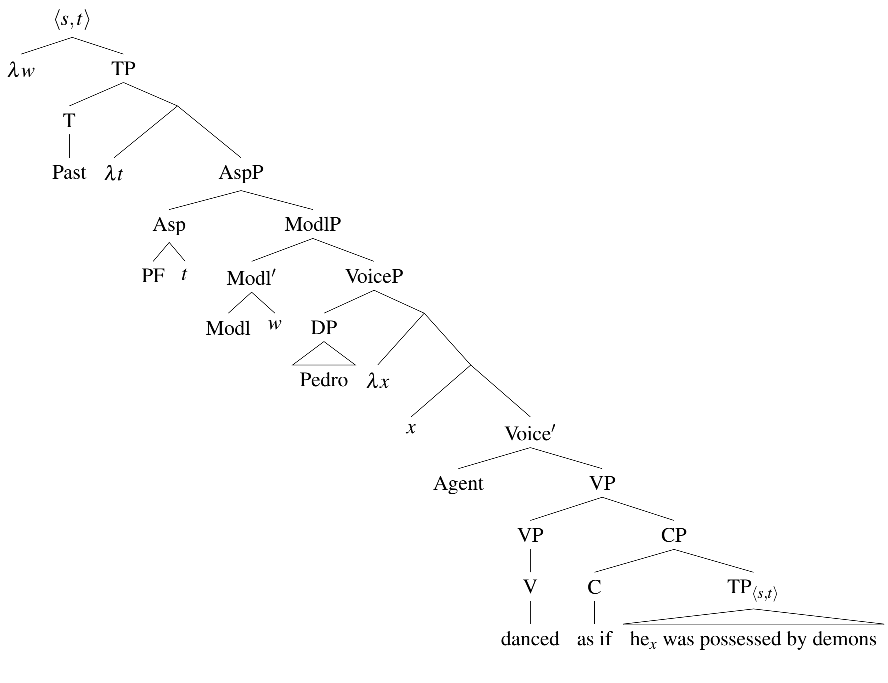
In words: f_c applied to e and p includes the eventuality e' iff e' is a counterpart of e occurring in one of the most normal p-worlds in which a counterpart of e occurs. *As if* is then interpreted in terms of f_c and r_c as follows:

(41) **Entry for *as if***
$[\![as\ if]\!]^{c,g} = \lambda p_{\langle s,t \rangle} \lambda e_v.\forall e'[e' \in f_c(e)(p) \rightarrow r_c(e)(e')]$

In words: *as if* takes a propositional argument p and returns a property of eventualities, which holds of e when it r_c-resembles all its counterparts selected by $f_c(e)(p)$.

3.2. A worked-out example

The entry (41) can be imported into a Beck and von Stechow (2015)-style clausal architecture to give a compositional analysis of (32) and related examples (see Zobel, 2016 for a closely related application of this architecture). We say "style" because we deviate from Beck & von Stechow in a number of respects—for instance, instead of treating tenses as operators, we adopt a referential analysis of tenses as pronouns (following Partee, 1973; Kratzer, 1998; Hacquard, 2006). We analyze (32) as follows:

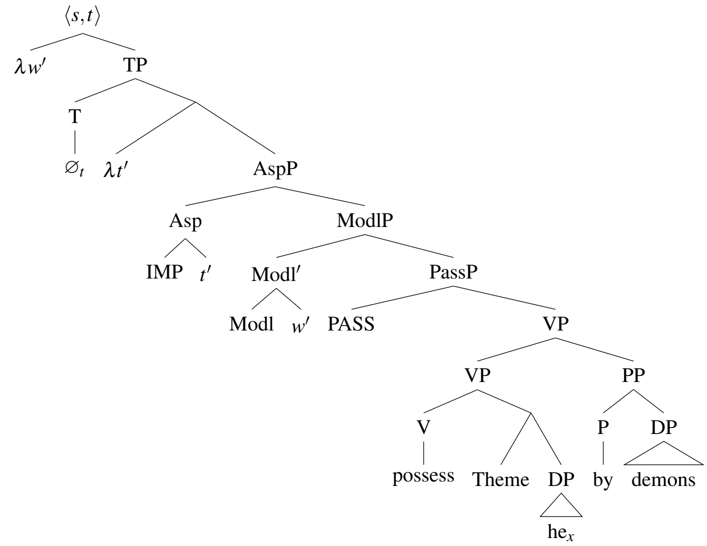


In the above LF, we classify the *as if*-phrase as a CP headed by the complementizer *as if* rather than a PP generated from an *if*-clause and preposition *as*, given our arguments for syntactic idiomaticity in §2.[11] The *as if* complementizer combines with the TP *he was possessed by*

[11]This categorial analysis agrees with that in Bender and Flickinger (1999) and Brook (2014) for the *as if*-complements of perception verbs. Asudeh (2002) argues for a PP analysis of *as if*-phrases, but we do not find

demons to form a property of eventualities of type $\langle v,t \rangle$. This property then composes with the interpretation of the matrix verb *danced* and its subject *Pedro* via the Agent function contributed by a silent voice head to form a more fine-grained property of type $\langle v,t \rangle$. A modal layer further refines this property by situating the event argument in world w. The perfective aspectual and tense layers existentially close the predicate denoted by the ModlP node and locate the runtime of the event within a contextually supplied reference time interval t_c preceding the utterance time. After abstracting over the world variable w, the output of the compositional machinery is a proposition of type $\langle s,t \rangle$.

Going into more detail now, we unpack the TP-complement of *as if* as follows:



To interpret the full LF, we help ourselves to a number of off-the-shelf ingredients. We adopt the following standard treatment of determiner phrases and a Heim and Kratzer (1998)-style bound variable analysis of the anaphoric pronoun *he* in the *as if*-phrase:[12]

(42) $[\![Pedro]\!]^{c,g} = \text{Pedro}$

(43) $[\![demons]\!]^{c,g} = \lambda x_e.\text{demon}(x)$

(44) $[\![he_x]\!]^{c,g} = g(x)$

Eventualities are introduced by a Neo-Davidsonian lexical semantics (Carlson, 1984; Parsons, 1990; Krifka, 1992; among others), where verbs denote properties of eventualities:

(45) $[\![dance]\!]^{c,g} = \lambda e_v.\text{dance}(e)$

(46) $[\![possess]\!]^{c,g} = \lambda e_v.\text{possess}(e)$

These eventualities are linked to their participants via thematic roles (functions of type $\langle v,e \rangle$,

his analysis persuasive. His main arguments are based on uniformities between *as if* and ordinary *as* and *if*—for instance, he observes that *as if*-phrases take the same pre-modifiers as prepositions and allow for subjunctive mood. But we didn't deny in §2 that *as if* is *as*-like and *if*-like in many respects, including those observed by Asudeh, and the evidence shows that *as if* is syntactically inflexible in ways that are surprising on a non-idiomatic PP treatment.

[12] Alternatively, one could give a referential analysis, as also discussed in Heim and Kratzer (1998).

such as Agent and Theme), which we take to have syntactic counterparts in LF, and we invoke the system of type-shifting operations in Champollion (2017) when required to compose verbal denotations with thematic information:

(47) $[\![Agent]\!]^{c,g} = \lambda e_v.\text{Agent}(e)$

(48) $[\![Theme]\!]^{c,g} = \lambda e_v.\text{Theme}(e)$

(49) **Type shifters**
a. $\lambda \theta_{\langle v,e\rangle} \lambda V_{\langle v,t\rangle} \lambda x_e \lambda e_v.V(e) \wedge \theta(e) = x$
b. $\lambda \theta_{\langle v,e\rangle} \lambda P_{\langle e,t\rangle} \lambda V_{\langle v,t\rangle} \lambda e_v.V(e) \wedge P(\theta(e))$

To account for the passivization of *possess* in the *as if*-phrase, we employ the following PASS operator and thematic analysis of *by*-phrases based on Landman (2000), which builds on the classic theory of passives in Dowty (1982):

(50) $[\![\text{PASS}]\!]^{c,g} = \lambda V_{\langle v,t\rangle} \lambda e_v.V(e) \wedge \exists x[\text{Agent}(e) = x]$[13]

(51) $[\![by]\!]^{c,g} = \lambda e_v.\text{Agent}(e)$

Higher up in the clausal hierarchy above VPs, Beck and von Stechow's (2015) Modl operator takes us from eventualities to possible worlds by assigning eventualities their modal trace (and introducing a world parameter in LF also gives modal operators higher up in the tree something to grab on to, though we do not explicitly show this here):

(52) $[\![\text{Modl}]\!]^{c,g} = \lambda w_s \lambda e_v.\omega(e) = w$

Higher still is the aspectual layer where a perfective or imperfective operator existentially binds the eventuality argument and takes us from eventualities to times by situating the "temporal trace" or "runtime" $\tau(e)$ of an eventuality e (Krifka, 1989) with respect to a time parameter t that can later be saturated with a reference time by Tense (the perfective operator PF is from Beck and von Stechow, 2015; the imperfective operator IMP is based on Kratzer, 1998 and Hacquard, 2006, though, as Hacquard discusses, non-perfective morphology appears in a range of environments and its semantics is far from settled):

(53) $[\![\text{PF}]\!]^{c,g} = \lambda t_i \lambda V_{\langle v,t\rangle}.\exists e[\tau(e) \subseteq t \wedge V(e)]$

(54) $[\![\text{IMP}]\!]^{c,g} = \lambda t_i \lambda V_{\langle v,t\rangle}.\exists e[t \subseteq \tau(e) \wedge V(e)]$

As mentioned, we treat tenses as pronouns (Partee, 1973; Kratzer, 1998; Hacquard, 2006). In particular, we assume that the TP layer above aspect supplies one of the following pronouns, where Present/Past have presuppositions that the reference time t_c is included in/precedes the time of evaluation t_c^* respectively, and the zero tense $\varnothing_t$ allows us to implement Kratzer's (1998) analysis of 'sequence of tense':

(55) **English tense pronouns**

[13] As we will see, when the Agent role in a passive construction is supplied by a *by*-phrase, the PASS operator is semantically redundant.

a. $[\![\text{Present}]\!]^{c,g} = t_c$. Defined in c only if $t_c^* \subseteq t_c$.
b. $[\![\text{Past}]\!]^{c,g} = t_c$. Defined in c only if $t_c < t_c^*$.
c. $[\![\varnothing_t]\!]^{c,g} = g(t)$.

Lastly, we need our entry for *as if*, repeated below as (56):

(56) $[\![as\ if]\!]^{c,g} = \lambda p_{\langle s,t\rangle} \lambda e_v.\forall e'[e' \in f_c(e)(p) \rightarrow r_c(e)(e')]$

Applying these semantic ingredients below the *as if* in (32), we interpret the embedded clause as follows:

(57) $[\![[_{\langle s,t\rangle} \lambda w' [_{\text{TP}} \varnothing_t [\lambda t' [_{\text{AspP}} [\text{IMP } t'] [_{\text{ModlP}} [\text{Modl } w']$
$[_{\text{PassP}} \text{PASS} [_{\text{VP}} [_{\text{VP}} possess [Theme [_{\text{DP}} he_x]]] [_{\text{PP}} by\ demons]]]]]]]]]]]^{c,g} =$
$\lambda w'_s.\exists e[g(t) \subseteq \tau(e) \wedge \omega(e) = w' \wedge \text{possess}(e) \wedge$
$\exists x[\text{Agent}(e) = x] \wedge \text{demon}(\text{Agent}(e)) \wedge \text{Theme}(e) = g(x)]$

Feeding this proposition into our *as if* entry then delivers this property of eventualities:

(58) $[\![[_{\text{CP}} as\ if [_{\text{TP}_{\langle s,t\rangle}} he_x\ was\ possessed\ by\ demons]]]\!]^{c,g} =$
$\lambda e_v.\forall e'[e' \in f_c(e)((57)) \rightarrow r_c(e)(e')]$

after which we interpret the full LF for (32) as follows:

(59) $[\![[_{\langle s,t\rangle} \lambda w [_{\text{TP}} \text{Past} [\lambda t [_{\text{AspP}} [\text{PF } t] [_{\text{ModlP}} [\text{Modl } w] [[_{\text{DP}} Pedro] [\lambda x [x [Agent [_{\text{VP}} [_{\text{VP}} danced]$
$[_{\text{CP}} as\ if [_{\langle s,t\rangle} he_x\ waspossessed\ by\ demons]]]]]]]]]]]]]\!]^{c,g} =$

$\lambda w_s.\exists e[\tau(e) \subseteq t_c \wedge \omega(e) = w \wedge \text{dance}(e) \wedge \text{Agent}(e) = \text{Pedro} \wedge$
$\forall e'[e' \in f_c(e)(p) \rightarrow r_c(e)(e')]$

where $p = \lambda w'_s.\exists e[t_c \subseteq \tau(e) \wedge \omega(e) = w' \wedge \text{possess}(e) \wedge$
$\exists x[\text{Agent}(e) = x] \wedge \text{demon}(\text{Agent}(e)) \wedge \text{Theme}(e) = \text{Pedro}]$

Defined in c only if $t_c < t_c^*$.

In words: There is an event e within some salient past time interval t_c that is a dancing by Pedro which r_c-resembles its counterparts in all the most stereotypical worlds in which Pedro was possessed by demons during t_c.

At this point, various bits of world knowledge—or rather, widely shared beliefs about other-worldly scenarios—come into play to derive the result that the manner of Pedro's dancing was wild. Raised on horror films like *The Exorcist* and *The Conjuring*, a hearer can surmise that a speaker who utters (32) is bringing up scenarios in which Pedro danced while possessed by demons because of the distinctive frenetic and uncontrolled manner in which people 'normally' act in such scenarios. In contrast, when the discourse context doesn't make any dimension of resemblance especially salient, or the comparison facilitated by an *as if*-phrase doesn't allow a hearer to extract a relevant property of the matrix eventuality, then manner uses sound odd (though still grammatical):

(60) A: How did Pedro dance?
B: ??He danced as if the earth was flat.

Assuming that this exchange takes place in a run-of-the-mill context where there is no special connection between manners of dancing and the curvature of the earth, B's answer doesn't help to resolve A's question.

3.3. Taking stock and generalizing

Our semantics for *as if* has clear comparative and conditional aspects. The comparativity is manifest in the resemblance parameter r_c, and the selection function f_c introduced in (40) should bring to mind standard accounts of indicative conditionals.

Compare for instance the influential Lewis-Heim-Kratzer "restrictor view" of indicatives, on which *if*-clauses serve to restrict the domain of nearby modal operators (Lewis 1975; Heim 1983; Kratzer 1986). On Kratzer's version of the theory, indicative conditionals always have a covert or overt modal in their complement, which quantifies over a set of possible worlds contributed by a *modal base* f that are maximal with respect to an *ordering source* g. When f encodes a speaker's information and g encodes stereotypicality, say, these parameters pick out the most typical worlds compatible with this information. To evaluate an indicative conditional, the proposition expressed by its antecedent is added to the modal base, thereby restricting the quantificational domain of the modal in its consequent to worlds in which this antecedent holds:

(61) **Kratzer's conditional semantics** (Kratzer, 1991, Def 13)
$[\![\text{if } \varphi \text{ must } \psi]\!]^{f,g} = [\![\text{must } \psi]\!]^{f^+,g}$ where $f^+(w) = f(w) \cup \{[\![\varphi]\!]^{f,g}\}$

A similar kind of domain restriction is built into our semantics for *as if.* One might roughly think of our selection function f_c as restricting the domain of comparison supplied by a stereotypical ordering source with the proposition expressed by the clause embedded under *as if.*

While we have used the manner report (32) as our representative example of modification with *as if*-adjuncts, our semantics is meant to extend to other adverbial uses as well. Indeed, the primary motivation for parameterizing *as if* to a contextually-supplied resemblance relation is to allow for comparisons in respects other than manner. Note that questions under discussion (QUDs; Roberts, 1996, 2012; Ginzburg, 1996; van Kuppevelt, 1996) often modulate the relevant dimension of comparison, given that *as if* claims, like assertions in general, must be relevant to the QUD (Roberts, 1996). For instance, if the QUD for (37) is *Where did the king meet with Annie?* (as we have assumed), then a locative reading is obtained. On the other hand, if the QUD is *How did the king behave towards Annie?*, we get a manner reading.

4. Coda on Perceptual Resemblance Reports

In this concluding section, we discuss how our analysis can be extended to the *as if*-complements of the perceptual source verbs *seem*, *appear*, *look*, *sound*, *feel*, *smell*, and *taste* in perceptual resemblance reports (PRRs) such as the following:

(62) Banner {seems/appears} to Thor as if he is morphing into Hulk.

(63) It {smells/sounds/tastes} as if we're in Italy.

On what seems to be the dominant view of PRRs in the copy raising literature, the relation to propositional attitude reports is tight: a speaker who utters (62) or (63) is taken to report the existence of an experiential state with the propositional content denoted by the TP embedded under *as if.* Asudeh and Toivonen (2012), for instance, would analyze the *seem*-variant of (62) as having the truth condition in (64), where "PSOURCE" and "PGOAL" are their labels for the source (Stimulus, more or less) and goal (Experiencer, more or less) of the perception (see Landau, 2011 for a closely related proposal):

(64) $\exists s[\text{seem}(s, [\![Banner\ is\ morphing\ into\ Hulk]\!]) \wedge$
$\text{PSOURCE}(s) = \text{Banner} \wedge \text{PGOAL}(s) = \text{Thor}]$

This event-semantic "informational" analysis assimilates PRRs to propositional attitude reports as analyzed by Hacquard (2006, 2010), who takes attitude verbs like *believe* to denote properties of "contentful" eventualities (see also Kratzer, 2006; Anand and Hacquard, 2008; Moulton, 2009, 2015; Rawlins, 2013a; Moltmann, 2017).

However, we have conceptual concerns about assimilating PRRs too closely to propositional attitude reports. First, if the function of *as if* in PRRs is just to link the reported state with its associated content, then the *as if*-complements of the perceptual source verbs are related neither to regular *if*-clauses nor to the ordinary preposition *as* in any obvious way. The *as if*-adjuncts analyzed in §3 had clear conditional and comparative dimensions, but these are now absent. Second, it often isn't clear how to understand the propositional content assigned under the informational semantics. Suppose I tell you "It looks as if Pedro is possessed" while watching him tear up the dance floor. What is the relevant state that has the propositional content that Pedro is possessed? It is tempting to say that this is just the content of my visual experience. But it is highly controversial that perceptual experiences represent high-level properties like being possessed by demons (see Siegel and Byrne, 2017 and the papers in Brogaard, 2014). Alternatively, one might say that it is some mental state caused by my visual experience that has the content that Pedro is possessed. But it can't be any perceptual belief more-or-less directly generated by my perception, nor a belief that I am readily disposed to form on the basis of this perception, because I certainly don't *believe* that Pedro is possessed, and I am not disposed to believe this. I don't even *accept* that he is possessed for the purposes of conversation (in the sense of Stalnaker, 1984). So it needs to be something else and we are unsure what that is.

Applying our hypothetical comparative semantics to the *as if*-phrases in PRRs allows us to avoid both worries. Building on Asudeh and Toivonen (2012) in that we assign the subject of a non-expletive-subject PRR the PSOURCE role and take *to*-PPs to contribute PGOALs, but breaking from their semantics in that we now apply our own entry (41) to the *as if*-complements of perceptual source verbs, we interpret the *seem*-variant of (62) as follows (with some details suppressed):

(65) $[\![[_{\langle s,t\rangle} \lambda w [_{\text{TP}} \text{Present}[\lambda t [_{\text{AspP}} [\text{IMP}\ t] [_{\text{ModlP}} [\text{Modl}\ w]$
$[[_{\text{DP}} Banner] [\lambda x [x [PSOURCE [_{\text{VP}} seems [[_{\text{PP}} to\ Thor]$
$[_{\text{CP}} as\ if [_{\langle s,t\rangle} he_x\ is\ morphing\ into\ Hulk]]]]]]]]]]]]]]]]\!]^{c,g} =$

$\lambda w_s.\exists s[\tau(s) \supseteq t_c \wedge \omega(s) = w \wedge \text{seem}(s) \wedge \text{PSOURCE}(s) = \text{Banner} \wedge \text{PGOAL}(s) = \text{Thor} \wedge$
$\forall s'[s' \in f_c(s)([\![Banner\ is\ morphing\ into\ Hulk]\!]^{c,g}) \to r_c(s)(s')]$

Defined in c only if $t_c^* \subseteq t_c$.

In words: There is a state of seeming s obtaining throughout the time of evaluation t_c^* whose source is Banner and goal is Thor that r_c-resembles each of its counterparts in the most stereotypical worlds in which Banner is morphing into Hulk during t_c^*. Note that on this analysis of (62), the proposition $[\![Banner\ is\ morphing\ into\ Hulk]\!]^{c,g}$ isn't attributed to the reported seeming state as its representational content but rather serves to restrict the selection of its counterparts by f_c to those in worlds where Banner is morphing into Hulk.

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The semantics of the (so-called) clausal determiner *nó* in Akan (Kwa)[1]

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Abstract. In Akan (Kwa), certain embedded clauses—relative clauses, clefts, temporal clauses, and subject CPs—can be followed by a determiner homophonous to the definite article *nó*. The prior literature considers this as part of a larger phenomenon of 'clausal determiners' attested in several Kwa languages. Some of these approaches analyse them unitarily as *event determiners*, which mark the event of the embedded clause as pre-mentioned or as mutually known (Akan: Boadi, 1974, Arkoh and Matthewson, 2013; Fɔ̀ngbe: Larson, 2003; Gungbe: Aboh, 2005; Gã: Renans, 2016a, Grubic and Renans, 2016). Based on original fieldwork on *nó* in relative clauses and cleft constructions, we argue against a unified analysis of clausal determiners as event determiners, showing that in relative clauses, the so-called clausal determiner operates at NP level, whereas this is not the case for cleft-*nó*.

Keywords: definiteness, clausal determiner, fieldwork semantics, Akan.

1. Introduction & Previous literature

In this paper, we examine the semantics of the so-called clausal determiner *nó* in Akan (Kwa, Niger-Congo). *Nó* is an NP-determiner (NP-*nó*) which marks definiteness, as shown in (1).

(1) Mè-tɔ̀-ɔ̀ *àtààdéɛ́ bí* ɛ̀nórà. **Àtààdéɛ́ nó** yɛ́ fɛ̀.
1SG-buy-PST dress INDF yesterday dress DEF COP nice
'I bought *a dress* yesterday. **The dress** is nice.'

However, *nó* also occurs as a clause-final element in embedded clauses such as a relative clause (RC-*nó*), as in (2a), cleft (cleft-*nó*), as in (2b), a temporal adverbial clause, as in (3a), and a complement subject clause, as in (3b). Thus, *nó* is referred to as a clausal determiner in constructions such as in (2)–(3), see e.g. Saah (1994).

(2) a. Pàpá [á ɔ̀-sá-àyɛ́ **nó**] á-brɛ́.
man REL 3SG-dance-PST NO PERF-tire out
(lit.) 'man that danced NO is tired out' (RC-*nó*)

b. Kofi nà ɔ̀-sá-àyɛ́ **nó**.
Kofi PRT 3SG-dance-PST NO
'It was KOFI who danced.' (Cleft-*nó*)

(3) a. Kofi sá-àyɛ́ **nó**, Kwaku dì-ì àhùrùsíé.
Kofi dance-PST NO Kwaku eat-PST cheer
'When Kofi danced, Kwaku cheered.' (Temporal Adverbial)

[1] Unless indicated otherwise, the data were collected in our own fieldwork. Glosses: 1/3 = 1st/3rd person, COMP = complementizer, COND = conditional, COP = copula, DEF = definite, FUT = future, IMPF = imperfective, INA = inanimate, INDF = indefinite, LOC = locative, NEG = negation, NO = *nó*, PERF = perfect, PL = plural, POSS = possessive, PROG = progressive, PRT = particle, PST = past, REL = relative clause, SG = singular. We thank all our language consultants, especially Emmanuel, Eric, Kwaku, the second Kwaku, and Owusua, as well as the audiences at Triple A 5 and Sinn und Bedeutung 23 for their comments. All remaining errors are our own.

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b. Sɛ́ Kofi túmí sá-àyɛ́ **nó** mà-à Kwaku ání gyè-èyɛ̀.
COMP Kofi be.able dance-PST NO cause-PST Kwaku eyes receive-PST
'That Kofi was able to dance made Kwaku happy.' (Subject CP)

The use of a definite determiner in embedded clauses is not unique to Akan but has been reported for many Kwa languages, including Fɔ́ngbe (Lefebvre, 1992, 1998), Gungbe (Aboh, 2005), Ewe (Ameka, 1991), Gã (Dakubu, 1992; Renans, 2016a, b; Grubic and Renans, 2016; Korsah, 2017), Logba (Dorvlo, 2008), as well as for other language families such as Gur (Mabia), e.g. Bùlì (Hiraiwa, 2002), Benue-Congo, e.g. Yòrùbá (Lefebvre, 1992), Kru, e.g. Vata (Hiraiwa, 2002) and Haitian Creole (Lefebvre, 1992). Generally, the so-called clausal determiner has been summarily analyzed as either marking a part of the information as backgrounded (Ameka, 1991 for Ewe; Grubic, 2015; Grubic and Renans, 2016 for Ngamo), marking the event of the embedded clause as (weakly) familiar (Gã: Renans, 2016a, b; Grubic and Renans, 2016), related to something pre-mentioned or mutually known (Fɔ́ngbe: Lefebvre and Brousseau, 2002), or simply marking some old information (Bùlì: Hiraiwa, 2002).

Similarly, in Akan, *nó* in embedded clauses as in (2)–(3) has been analyzed as an *event* determiner indicating old/known information (Saah, 1994, 2010), mutual knowledge (Arkoh, 2011), familiarity (Arkoh and Matthewson, 2013) and presupposed information (Amfo and Fretheim, 2005). Thus, the prevailing analyses argue for a unified account of clausal determiners.

In this paper, however, we present a systematic study of *nó* in relative clauses (RC-*nó*) and clefts (cleft-*nó*) and show that a unified account of clausal determiners as event determiners is not tenable. Our data show that while RC-*nó* behaves semantically like NP-*nó*, cleft-*nó* has a different semantic function from NP-*nó* and RC-*nó*. The rest of the paper proceeds as follows: Section 2 discusses the main data supporting our analysis of RC-*nó* as a run-of-the-mill determiner. Section 3 presents an analysis of RC-*nó* and NP-*nó* data. Section 4 describes the differing behaviour of cleft-*nó*. Section 5 presents the summary and conclusion.

2. Data: NP-*nó* and RC-*nó*

2.1. Language & Method

Before turning to the main argumentation, this section presents some basic facts about the Akan language and about the methods used in data collection. Akan (Kwa, Niger-Congo) is a group of mutually intelligible dialects spoken mostly in Ghana. The data in this paper come from the Asante Twi dialect of the language (2.8 million speakers; Lewis et al., 2018), which, like other major varieties of Akan, has its own orthography (adopted here). Akan, and in particular Asante Twi, has SVO as its basic word order, and distinguishes between high (´) and low (`) tones. Concerning DP-syntax, most NP modifiers (adjectives, RCs), as well as determiners, follow the noun.

Most data presented in this paper come from elicitations with five speakers of Asante Twi in Berlin/Potsdam (Germany), who carried out translation and felicity judgement tasks following the guidelines for semantic fieldwork found in Matthewson (2004). Each sentence was seen by at least two speakers. The judgments were subsequently corroborated by one of the authors of this paper, Reginald Duah, who is a native speaker of Asante Twi. We additionally conducted a written questionnaire on cleft-*nó* with twenty Akan speakers at the University of Ghana, Legon.

2.2. The definite article *nó*

Our main claim is that RC-*nó* is a variant of the run-of-the-mill determiner (NP-*nó*). This section outlines the basic properties of this determiner, which is argued to be a definite determiner encoding uniqueness, *pace* Arkoh and Matthewson (2013). Starting with its definiteness status, *nó* does not pass a number of diagnostics for indefiniteness presented in Matthewson (1999), unlike the indefinite *bí*. First, as shown in (4), an NP containing *nó* (here: *ànòmàá nó* 'the bird') cannot refer to an entity introduced by a potential antecedent that is not unique (here: the plural *ǹnòmàá m̀mìɛ̀ǹsá* 'birds').

(4) Dùá bí sì m̀pómá nó ákyí, nà *ǹ-nòmàá m̀mìɛ̀ǹsá* sí só.
tree INDF be.on window DEF behind and PL-bird three be.on top
'There is a tree behind the window, and three birds are sitting on it.'
... m̀-màrímáá nó nyìnáá hù-ù **à-nòmàá #nó / bí**
... PL-boy DEF all see-PST SG-bird DEF / INDF
'All the boys saw #the / a bird. '

Second, unlike NPs containing the indefinite determiner *bí*, *nó*-NPs cannot introduce new referents that are not known to be unique:

(5) Context (adapted): Nana starts a conversation with a stranger: *Yesterday, I was at the bar and...*
...**pàpá #no / bí** bà-à hɔ̀. Pàpá nó kyèá-à òbíárá.
man DEF / INDF arrive-PST there man DEF greet-PST everybody
'#The/A man arrived. The man greeted everybody.'

Comment: *[Nó-variant] The person knows the papa. If you don't know him you can't say the sentence.*

Finally, two *nó*-NPs with the same nominal property (here: *àkwàdàá* 'child') cannot refer to two different entities. This is not the case for *bí*.

(6) Context: A teacher at a nursery school is explaining how her first day went. She doesn't know the other person very well, and they haven't talked about anyone before: *It was crazy, and I didn't have time to do anything...*
T: Ná **àkwàdàá #nó / bí** rè-sú nà **àkwàdàá #nó / bí** ré-dí àgórɔ́.
PRT child DEF / INDF PROG-cry and child DEF / INDF PROG-eat game
'#The/A child was crying and #the/a child was playing'.

Having established that *nó* is a definite determiner, the question arises as to what exactly it encodes. In Arkoh and Matthewson (2013), *nó* was characterized as a familiarity definite in the sense of Schwarz (2009). In Schwarz's original proposal—though not necessarily in Arkoh and Matthewson (2013), who modify the definition—familiarity definites are only licensed in anaphora contexts (reference to an overt antecedent, e.g. (7)), and some cases of bridging.

(7) Mè-tɔ̀-ɔ̀ *àtààdéɛ́ bí* ɛ̀nórà. **Àtààdéɛ́ nó** yɛ́ fɛ̀.
1SG-buy-PST dress INDF yesterday dress DEF COP nice
'I bought *a dress* yesterday. **The dress** is nice.' (Bombi, 2018: 148)

However, as shown in Bombi (2018), *nó* can also be found in uses characteristic of uniqueness definites in the sense of Schwarz (2009), such as larger situations, as in (8), immediate situations, as in (9a), as well as (part-whole) bridging, as in (10).

(8) Context: Afia is sitting on a bus, when a woman she doesn't know sits down beside her. The woman says:
Àwìà nó ré-bɔ̀ ɛ̀nnɛ́.
sun DEF PROG-hit today
'The sun is shining today.' (Bombi, 2018: 150)

(9) a. Context: Kofi and Amma are in the market. Amma disappears and comes back with one dress in her hands. Kofi says:
Mè-pɛ̀ **àtààdéɛ́ nó**.
1SG-like dress DEF
'I like the dress.' (Bombi, 2018: 150)
b. Context: Kofi and Amma are in the market. Amma disappears and comes back with several dresses in her hands. ⇒ *nó* is **not possible** in this context.

(10) Beginning of a newspaper article: *Recently, there was a government meeting ...*
a. **ɔ̀màǹpànyíń nó** dùrù-ù hɔ́ ànàdwó ǹ-nɔ́ń dú.
president DEF arrive-PST there night PL-bell ten
'The president arrived at 10pm.'
b. #**ɔ̀sòàfóɔ́ nó** dùrù-ù hɔ́ ànàdwó ǹ-nɔ́ń dú.
minister DEF arrive-PST there night PL-bell ten
'The minister arrived at 10pm.'

In light of this, *nó* is more adequately characterised as a definite which, similar to English *the*, can appear in both uniqueness and familiarity contexts (see Bombi, 2018 for more details).[2]

2.3. Comparison of RC-*nó* and NP-*nó*

Having characterised NP-*nó*, we can now turn to its relative clause counterpart. What we show is that it displays the same semantic properties as NP-*nó*.

First, RC-*nó* does not pass the indefiniteness tests presented in the previous section, showing that the determiner contributes definiteness. By contrast, the same sentences are felicitous with the indefinite *bí*. First, a plural NP cannot serve as an antecedent to an RC-*nó* construction, as shown in (11) (cf. (4), the equivalent NP-*nó* example).

(11) Dùá bí sì m̀pómá nó ákyí, nà *ǹ-nòmàá m̀mìɛ̀ǹsá* sí só.
tree INDF be.on window DEF behind and PL-bird three be.on top
'There is a tree behind the window, and three birds are sitting on it.'
a. ... m̀-màrímá nó nyìnáá hù-ù **à-nòmàá bí** [á ɔ̀-sí dùá nó só].
... PL-man DEF all see-PST SG-bird INDF REL 3SG-sit tree DEF on
'All the men saw a bird sitting on the tree.'
b. #... m̀-màrímá nó nyìnáá hù-ù **à-nòmàá** [á ɔ̀-sí dùá nó só **nó**].
... PL-man DEF all see-PST SG-bird REL 3SG-sit tree DEF on NO
'All the men saw the bird sitting on the tree.'

[2]In §3 we analyse *nó* as a Fregean uniqueness definite, which we assume to also capture familiarity contexts. We thereby do not imply that *nó* is a uniqueness definite *sensu* Schwarz (2009), i.e. limited to uniqueness contexts.

Second, like NP-*nó* in (5), RC-*nó* constructions cannot introduce new referents (12).

(12) Context: Nana starts a conversation with a stranger: *Yesterday I was at the bar and...*
a. ... **pápá bí** [á ɔ̀-téná-à Berlin] bà-à hɔ́.
... man INDF REL sit-PST Berlin arrive-PST there
'A man who lived in Berlin arrived.'
b. #... **pàpá** [á ɔ̀-téná-à Berlin **nó**] bà-à hɔ́.
... man REL 3SG-sit-PST Berlin NO arrive-PST there
'The man who lived in Berlin arrived.'

Finally, as shown in (13), two RC-*nó* constructions with the same NP+RC property cannot refer to two different entities, similar to NP-*nó* in (6).

(13) Context: A teacher at a nursery school is explaining how her first day went. She works at an international school with children from all around the world—for example, there are several children from Spain, several children from England, several children from Italy, etc. The teacher doesn't know the other person very well, and they haven't talked about anyone before. The teacher says: *It was crazy, and I had no time to do anything...*
a. ... **Àbɔ̀frá bí** [á ɔ̀-fírí Spain] rè-sú nà (**àbɔ̀frá**) (**bààkó**)
... child INDF REL 3SG-come.out Spain PROG-cry and child one
bí [á ɔ̀-fírí Spain] ré-dí àgórɔ́.
INDF REL 3SG-come.out Spain PROG-eat game
'A child who was from Spain was crying and (another) child who was from Spain was playing.'
b. ... #**Àbɔ̀frá** [á ɔ̀-fírí Spain **nó**] rè-sú nà **àbɔ̀frá** [á
... child REL 3SG-come.out Spain NO PROG-cry and child REL
ɔ̀-fírí Spain **nó**] ré-dí àgórɔ́.
3SG-come.out Spain NO PROG-eat game
'The child who was from Spain was crying and the child who was from Spain was playing.

These diagnostics support the idea that RC-*nó*, like NP-*nó*, contributes definiteness at NP level. Additionally, like with NP-*nó*, there is evidence that uniqueness is a notion relevant for the distribution of RC-*nó*. Consider (14) and the equivalent NP-*nó* example in (10).

(14) Beginning of a newspaper article: *Recently, there was a government meeting* ...
a. ... **ɔ̀sòáfóɔ́** [á ɔ́-hwɛ́ àm̀mámérɛ́ só **nó**] dùrù-ù hɔ́ ànàdwó ǹ-nɔ́ń
... minister REL 3SG-look culture top NO arrive-PST there night PL-bell
dú.
ten
'The minister of culture arrived at 10pm.' (lit. minister who looks on culture)
b. ... #**ɔ̀pànyíń** [á ɔ̀-fírí Kumase **nó**].
... elder REL 3SG-come.from Kumase NO
'The elder who comes from Kumase arrived at 10pm.'

In (14a), RC-*nó* is felicitous. This is because, by common knowledge, it is in the common ground that a country only has one minister of culture, licensing *nó*. By contrast, in (14b) uniqueness is not guaranteed: typically, in each Ghanaian town there is more than one elder. In this context, RC-*nó* is not acceptable. Similar observations apply to (15):

(15) Context: Dufie and Priscilla go to a party. During the party, they watch one man dancing. On the following day, Dufie says to Priscilla:
a. **Pàpá** [á ná ɔ̀-ré-sá **nó**] bìsá-à mè mè nɔ́mà.
man REL IMPF 3SG-PROG-dance NO ask-PST 1SG 1SG.POSS number
'The man who was dancing asked me for my number.'
b. Same context, but there are several men dancing
⇒ RC-*nó* cannot be used.

In (15a) the situation described by Dufie (witnessed by both interlocutors) contains only one man dancing, licensing RC-*nó*. By contrast, if the same situation contains several dancers, as in (15b), the expression becomes infelicitous. Note that the uniqueness applies to the NP+RC property (≈ there was only one man who was dancing), rather than just the RC-property (≈ there was only one entity dancing), an option suggested by a reviewer. Indeed, as shown in (16), the RC-*nó* construction (here: *The man who was dancing*) is felicitous even if there were many female dancers in addition to the man referred to by the construction.

(16) Context: Dufie and Priscilla go to a party. At the party, there are many women but only one man. Everyone is dancing. On the following day, Dufie says to Priscilla:
Pàpá [á ná ɔ̀-ré-sá **nó**] bìsá-à mè mè nɔ́mà.
man REL IMPF 3SG-PROG-dance NO ask-PST 1SG 1SG.POSS number
'The man who was dancing asked me for my number.'

Overall then, RC-*nó* passes the same indefiniteness and uniqueness diagnostics as NP-*nó*, supporting the idea that it is an instantiation of the run-of-the-mill definite determiner.

2.4. Potential counterarguments

Despite the data presented so far, some examples in the literature seem to contradict our previous conclusions, suggesting, more or less explicitly, that RC-*nó* is not operating at NP-level. Here we evaluate these potential counterarguments to our analysis, and conclude that they do not hold up to scrutiny.

The first counterargument is the apparent optionality of RC-*nó*. In running examples in the literature, the clause-final *nó* is sometimes presented as optional, as shown below:

(17) Ònípá [á mé hú-ù nó (**nó**)].
person REL 1SG see-PST 3SG NO
'The person that I saw.' (Ofori, 2011:247)

In (17), *nó* can but does not have to be be inserted, and no difference is indicated in the translation. If RC-*nó* really is an NP-determiner, similar to English *the*, the optionality shown in (17) is unexpected. Indeed, assuming that the principle of Maximize Presupposition holds in Akan, the determiner *nó* should be inserted whenever uniqueness is satisfied in the context.

However, our own elicitations show that inserting RC-*nó* has semantic effects, undermining this idea of optionality. As shown in (18), the bare noun can be used in contexts where the individual is not unique, whereas the insertion of RC-*nó* forces a definite reading.

(18) Context: Beginning of a Wikipedia article.
Barcelona yɛ̀ **kùró** [à ɛ̀-wɔ́ Spain **(#nó)**].
Barcelona COP city REL 3SG-LOC Spain NO
'Barcelona is a/the city in Spain.'[3]
Comment: *[With nó] Maybe I was talking with somebody about Barcelona—"that city in Spain"*.

Admittedly, there are cases of true optionality, as shown in (19):

(19) Beginning of a newspaper article: *Recently, there was a government meeting*...
ɔ̀sòáfóɔ́ [á ɔ́-hwɛ́ àm̀mámérɛ́ só **(nó)**] dùrù-ù hɔ́ ànàdwó ǹ-nɔ́ń dú.
minister REL 3SG-look culture top NO arrive-PST there night PL-bell ten
'The minister of culture (lit. minister who looks on culture) arrived at 10pm.'

Here, the consultants reported no difference between the variant with *nó* and the one without, and both versions received a definite interpretation. However, it has to be noted that a similar phenomenon can be observed for NP-*nó*, as shown below.

(20) Beginning of a newspaper article: *Recently, there was a government meeting* ...
ɔ̀màǹpànyíń (**nó**) dùrù-ù hɔ́ ànàdwó ǹ-nɔ̀ǹ dú.
president DEF arrive-PST there night PL-bell ten
'The president arrived at 10pm.'

Similar to (19), in (20) the bare noun already has a definite interpretation and adding *nó* does not seem to have any truth-conditional consequences. It has to be noted that the examples appear to have lexical restrictions: they always involve nouns referring to human entities that potentially can be addressed with a title, e.g. *president, teacher, pastor*.[4] Both properties are exemplified in (20). While this optionality is still puzzling if Maximize Presupposition holds, an analysis of the phenomenon will have to capture both RC-*nó* and NP-*nó* examples, supporting the idea that we are dealing with the same determiner in both cases.

The second apparent counterexample to our analysis of RC-*nó* is that it can appear even when the head noun is a *bí* indefinite, as in (21).

(21) **Káà bí** [á Kofi dé bá-à há **nó**] yɛ̀ Toyota.
Car INDF REL Kofi take come-PST here NO be Toyota
'The car that Kofi brought here is a Toyota.' (Saah, 2010:97)

Under the assumption that definite and indefinite determiners do not co-occur in the same phrase, this example suggests that RC-*nó* is not operating at NP-level, but it is for instance modifying some element of the embedded relative clause.

However, it turns out that in Akan indefinite-definite combinations are possible, as illustrated in (22).

[3]Proper nouns (of places) do not take definite articles: *#Spain no*.
[4]This characterization is based on preliminary evidence, to be confirmed in future research.

(22) Context: Dufie and Priscilla go to a party. During the party, they watch one man dancing. On the following day, Dufie says to Priscilla:
Pàpá bí nó bìsá-à mè mè nɔ́mà.
man INDF DEF ask-PST 1SG 1SG.POSS number
'After the party, that certain man asked me for my number.'

In this construction, the whole DP becomes definite. Addionally, judging by the speakers' translations and comments, the NP receives the additional import that the addressee has to make an effort to retrieve the referent (so called 'recognitional us' of the definite, translated as *that certain*, *the one who*, etc., Diessel (1999)). There is evidence that the *bí-nó* combination in (21) with RC-*nó* and in (22) with NP-*nó* involve the same phenomenon: the RC-*nó* example also involves definiteness. As shown in (23), the RC-*nó* construction can only be used if there is only one entity with the NP+RC property (here: *one man who is dancing*).

(23) Dufie and Priscilla go to a party. During the party, they watch one man dancing. On the following day, Dufie says to Priscilla:
a. ...**Pàpá bí** [á ná ɔ̀-ré-sá **nó**] bìsá-à mè mè nɔ́mà.
...man INDF REL IMPF 3SG-PROG-dance DEF ask-PST 1SG 1SG.POSS number
'That certain man who was dancing asked me for my number.'
b. Same context, but there are several men dancing.
⇒ RC-*nó* is infelicitous.

A further argument for treating both constructions as involving the same phenomenon is that another syntactic ordering is also possible, where the relative clause follows both *bí* and *nó*, as in (24). The reading is the same as for the alternative word order shown in (23).

(24) Mè-rè-sùsú **àtààdéɛ́ bí nó** à mé-tɔ́-ɔ̀ ɛ̀nórà.
1SG-PROG-try dress INDF DEF REL 1SG-buy-PST yesterday
'I am trying on that one dress that I bought yesterday.'

To sum up the data from Section 2, we argued that RC-*nó* makes the same semantic contribution as NP-*nó*, namely that of a definite determiner at NP-level, whose definition involves some notion of uniqueness. We also discussed two counterarguments to our analysis and concluded that they are not on the right track.

3. Analysis

This section provides an analysis of the phenomena discussed in section 2. We first introduce our analysis of *nó* (as NP- and RC-*nó*) in Section 3.1. We then address the counterarguments from Section 2.4 and provide an analysis of bare nouns in Section 3.2 as well as of the indefinite determiner *bí* and of its co-occurrence with *nó* in Section 3.3.

3.1. Proposal for *nó*

We propose the lexical entry in (25) for *nó*, i.e. the presuppositional lexical entry assumed for the definite determiner in English in Heim and Kratzer (1998: 75, i.a.).

(25) $[\![\text{nó}]\!] = \lambda P \in D_{\langle e,t \rangle}: \exists! x[P(x) = 1].\ \iota x[P(x) = 1]$

Since, as argued in Section 2.4, uniqueness has to hold for an individual that has both the property denoted by the head noun and the relative clause, the argument of the determiner has to be an NP composed of the noun and the relative clause, as in (26).

(26)
$$[_{\mathrm{DP}_e}\ \text{nó}_{\langle\langle e,t\rangle,e\rangle}\ [_{\mathrm{NP2}_{\langle e,t\rangle}}\ [_{\mathrm{NP1}}\ \text{man}]\ [_{\mathrm{CP}}\ \text{who danced}]]]$$

We remain agnostic on how exactly the two surface word orders found with relative clauses, i.e. N-RC-det (RC-*nó*) and N-det-RC, are derived from this structure but would like to point out some observations that a syntactic account would have to capture.[5] First, since in the N-det-RC word order, the noun can, for example, be modified by an adjective, this word order is not derived via head movement of N to D. Second, we find some examples where NP- and RC-*nó* co-occur, see example (27a), which was judged as interchangeable with (27b-c) (other languages with determiner doubling include, for example, Greek, Hebrew, Arabic, Romanian; see Alexiadou, 2014 and Plank, 2003 for extensive discussions).[6]

(27) Context: Dufie and Priscilla go to a party. At the party, there are many women but only one man. Everyone is dancing. On the following day, Dufie says to Priscilla:

a. Pàpá **nó** [á ná ɔ̀-ré-sá **nó**] bìsá-à mè mè nɔ́mà.
man DEF REL IMPF 3SG-PROG-dance DEF ask-PERF 1SG 1SG.POSS number

b. Pàpá **nó** [á ná ɔ̀-ré-sá] bìsá-à mè mè nɔ́mà.
man DEF REL IMPF 3SG-PROG-dance ask-PERF 1SG 1SG.POSS number

c. Pàpá [á ná ɔ̀-ré-sá **nó**] bìsá-à mè mè nɔ́mà.
man REL IMPF 3SG-PROG-dance DEF ask-PERF 1SG 1SG.POSS number
'The man who was dancing asked me for my number.'

Third, in principle it is possible to derive the different orderings via NP-movement to Spec-DP (see e.g. Cinque's 2004 analysis of Romanian, pace e.g. Giusti, 1995): the N-det-RC word order would be derived by moving NP1 and the N-RC-det order would be derived by moving NP2 (our RC-*nó* construction).[7] However, this derivation becomes problematic when considering the combination with *bí*: as shown in examples (23)–(24) above, the word orders N-bi-RC-no and N-bi-no-RC are possible. Crucially, however, N-RC-bi-no is ungrammatical. It is not immediately apparent why the movement of NP2 cannot work for the latter construction and thus account for all the observations made here.

3.2. The interpretation of bare nouns

In section 2.4, we showed that bare nouns in Akan are usually indefinite. We also presented some examples of definite bare nouns but noted that they had a rather restricted distribution

[5] McCracken (2013: 16), noting that different Kwa languages differ concerning the relative linear order of the relative clause and the determiner, simply hypothesizes that the reason for the variation in Akan could be language change, i.e. a switch from one word order to the other.

[6] Though sometimes the double *nó* variant was preferred in elicitation. The source of preference is unclear to us and is left for further research.

[7] See for example Aboh (2005) for a phrasal movement account for Gungbe as well as de Vries (2002), as discussed in Salzmann (2017: 129).

(pace Arkoh and Matthewson, 2013). This section presents an account of bare noun distribution, based on some additional data.

Starting with indefinite readings, bare nouns can receive a narrow-scope but not a wide-scope existential reading, as shown in (28) (based on an example in Deal and Nee, 2018). They can also have a kind reading, as demonstrated in (29).

(28) *Wide-scope indefinite:* There are 4 dogs and 3 of them are in a basket. We want to say there's one that is not in the basket [...]:
ɔ̀krámáń #(**bààkó**) ń-hyɛ́ kɛ̀ǹtɛ́ń nó mú.
dog one NEG-be basket DEF inside
'A dog isn't in the basket.'
Comment: *[with the bare noun] It means there is no dog in the basket.*

(29) *Kind reading:* [A children's biology book] describes animals of different types - mice, rats, pigs... Then [a further animal] is described:
Krámáń ń-yɛ́ nà.
dog NEG-be rare
(lit.) 'Dog isn't rare.'

In Section 2.4 we presented some examples where bare nouns seemed to have a definite interpretation, apparently contradicting our previous claim. However, these kinds of examples are very restricted. In particular, they are not possible in anaphora contexts, as shown in (30), and situational uniqueness contexts, as presented in (31).

(30) *Anaphora:*
Mè-tɔ̀-ɔ̀ *àtààdéɛ́ bí* ńnórà. **Àtààdéɛ́** #(**nó**) yɛ́ fɛ̀.
1SG-buy-PST dress INDF yesterday. Dress DEF COP nice
'I bought a dress yesterday. The dress was nice.'

(31) *Situational uniqueness:* Badu goes to a naming ceremony [...].[8] After the libations, everybody is waiting for the next step to happen. A relative of the child approaches Bediako. They haven't spoken before or talked about anyone. The relative says:
Àkwàdàá #(nó) rè-sú ńtí m̀pànyìǹfóɔ́ nó bɛ́-twɛ́ń á-mà nó
Child DEF PROG-cry so elders DEF FUT-wait CONS-give 3SG.PRON
á-gyàè.
CONS-stop
'The child is crying, so the elders will wait until he calms down.'

Instead, as we noted above, it seems that the kind of nouns that are licit as definite bare nouns, e.g. *president, teacher, minister of culture* are titles of certain unique individuals. Considering the lexical restrictions that we have observed, we are currently pursuing the hypothesis that they are to be analysed as proper nouns rather than as definite descriptions.

The interpretation of bare nouns in Akan is compatible with accounts assuming a system of typeshifts, which are only available if there are no overt determiners with the same meaning (e.g. Chierchia, 1998; Dayal, 2004; based on Partee, 1987). For singular bare nouns of type $\langle e,t\rangle$, Chierchia (1998) assumes that in principle two typeshifts are possible. The first is a ι-

[8]In naming ceremonies, there is usually one child who is being given a name.

(bare singular nouns)	Predictions		Findings
	Chierchia	Dayal	Akan
indefinite: wide and narrow scope *a particular dog/any dog*	✓ ∃	✗ –	✗ –
indefinite: only narrow scope *any dog*	✗ –	✓ ι	✓ ι
definite: anaphoric *a dress...the dress*	✓ ι	✓ ι	✗ blocked by *nó*
definite: sit. unique *the child*	✓ ι	✓ ι	✗ blocked by *nó*
kind *dog isn't rare*	✓ ι + int.	✓ ι + int.	✓ ι + int.

Table 1: Bare nouns: Predictions and findings

typeshift yielding a definite interpretation, which is blocked if the language has an overt definite determiner. In Akan, the ι-typeshift is blocked by the definite article *nó*, explaining why the bare noun is not available in (30)–(31). For the kind of examples where a definite interpretation superficially appears to be available, as in (19)–(20), a proper noun analysis would account for their availability as follows. Proper nouns, being of type e, are not predicted to undergo any typeshift under Chierchia's account, meaning that they are also not blocked in any way by *nó*. Additionally, Maximize Presupposition is not operative: proper names involve a uniqueness presupposition similar to that of NP-*nó*, and thus are not in competition in the relevant sense for this principle.

The second typeshift that Chierchia assumes is an ∃-typeshift from $\langle e,t\rangle$ to $\langle\langle e,t\rangle,t\rangle$ yielding an existential quantifier reading, which is blocked if there is an overt existential quantificational determiner in the language. Since we do not assume the indefinite determiner *bí* to be an existential quantificational determiner,[9] the ∃-typeshift should be possible for Akan (Chierchia, 1998: 374), yielding narrow and wide-scope existential readings. However, only narrow scope readings are available in Akan, mirroring the findings of Dayal (2004) for Hindi and Russian. Dayal argues instead that the ι-typeshift is responsible for all available readings of singular bare count nouns in Hindi and Russian (see Table 1). This analysis can be adopted for Akan, if we make the additional assumption that the definiteness readings are blocked by the availability of *nó* in these contexts.[10]

3.3. Co-occurrence of *nó* and *bí*

We saw in section 2.4 that the indefinite determiner can co-occur with *nó* (with both the RC-*nó* and the NP-*nó* variant) and that the construction retained a definite interpretation. To analyse

[9]We discuss it in detail below in Section 3.3.

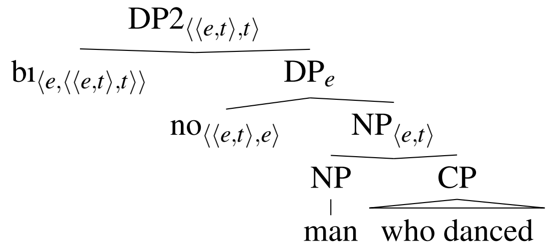
[10]This is reminiscent of English plurals (Dayal, 2004). The definite determiner blocks anaphoric uses of bare nouns, but not kind readings, as shown in (i).

(i) a. I saw some dogs$_i$. *(The) dogs$_i$ were wagging their tails.

b. (*The) dogs are widespread.

this, we propose a choice function analyisis of *bí*, which we justify in what follows. We posit the LF in (32). Considering this structure, an analysis of *bi* as an existential quantificational determiner of type $\langle e, \langle\langle e,t\rangle,t\rangle\rangle$ (following Matthewson, 2001) suggests itself, since it requires its first argument to be an individual (type *e*) and the *nó*-DP is in fact of type *e*:

(32)



However, a careful investigation of the scope-taking properties of *bí* indefinites suggests that the determiner cannot be an existential quantificational determiner. *Bí* indefinites have the option of narrow or wide scope with respect to another operator (e.g. *pɛ* 'want' in (33)–(34), *biara*-QPs), which is compatible with an analysis as an existential quantifier.

(33) *Narrow scope:* Ama doesn't know any teacher, but she believes that she would be happy as the wife of a teacher - no matter which teacher. [...]
Ama pɛ̀ sɛ́ **ɔ̀kyèrɛ̀kyérɛ̀ní bí** wáré nó.
Ama want COMP teacher INDF marry 3SG
'Ama wants a teacher to marry her.'
$\forall$w' $\in$ $\text{Boul}_{Ama,w}$[$\exists$x[teacher(x) $\wedge$ marries(Ama)(x)(w')]]

(34) *Wide scope:* Ama dislikes most teachers, but she knows one teacher, Kwame, that she likes very much, and she wants him to marry her. [...]
$\rightarrow$ Sentence (33) also accepted
$\exists$x[teacher(x) $\wedge$ $\forall$w' $\in$ $\text{Boul}_{Ama,w}$[marries(Ama)(x)(w')]]

Bí indefinites can also have exceptional wide scope, i.e. they appear to take scope out of an island, e.g. an *if*-clause, as presented in (35). Since quantifier movement usually obeys island restrictions, this was used as an argument against a quantifier analysis for *bí* and for an analysis of *bí* as a choice function in Arkoh (2011), following similar proposals for English *some* in Winter (1997); Reinhart (1997); Kratzer (1998).

(35) *Exceptional wide scope:* You are a member of the local government and are organizing a vote concerning a certain law. All elders are in favor of this law, but one of the elders is particularly powerful, while the others have less power. If this elder comes, the law will be passed. If only the other elders come, it is not certain. [...]
Sɛ̀ **ɔ̀pànyíń bí** bá á, yɛ̀-bɛ́-hyɛ́ m̀mrá nó.
if elder INDF come COND 1PL-FUT-force law 3SG
'If a (certain) elder comes, we will pass the law.'
$\exists$x[elder(x) $\wedge$ [come(x) $\rightarrow$ we-pass-the-law]]

However, in Akan, overt movement does not obey island constraints (e.g. Saah, 1994), as shown in (36).

(36) *Wh-movement:* You are a member of the local government and are organizing a vote concerning a certain law. There is a certain person that is in favor of this law, and very

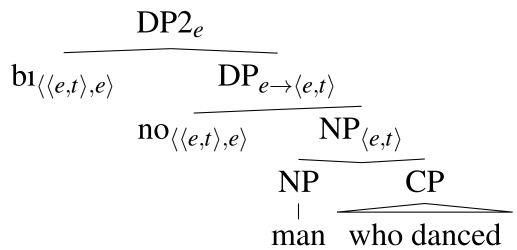
powerful. If this person comes, the law will be passed. A new colleague, whom you haven't talked to before, approaches you and wants to know the name of this person. He asks:
Hwáń nà sɛ̀ ɔ̀-bá á, yɛ̀-bɛ́-hyɛ́ m̀mrá nó?
who PRT if 3SG-come COND 1PL-FUT-force law 3SG
(lit.) 'Who, if he comes, we will pass the law?'

Thus, an analysis of *bí* as an existential quantifier would still be possible, under the assumption that quantifier movement at LF does not obey island constraints either. We, however, assume a choice-functional analysis, due to examples like (37). Ruys (2016) and Reinhart (1997) argue that quantifier raising out of the *if*-clause should lead to a wide-scope distributive reading ('if any of the three elders comes, we will pass the law'). The fact that this reading is not possible in Akan suggests that a quantifier analysis for *bí* indefinites is on the wrong track. We therefore adopt Arkoh's (2011) analysis of *bí* as a choice function, defined in (38).

(37) *Wide-scope distributive reading:* [...] All elders are in favor of this law, but three elders are particularly powerful, the others have less power. If one of these three elders comes—no matter who—the law will be passed. If only the other elders come, it is not certain that the law will be passed. [...]
#Sɛ̀ **m̀pànyínfóɔ́ m̀mìɛ̀ǹsá bí** bà à, yɛ̀-bɛ́-hyɛ́ m̀mrá nó.
if elders three INDF come COND 1PL-FUT-force law 3SG
'If three elders come, we will pass the law.'
$\exists$ three x [elders(x) $\wedge$ [come(x) $\rightarrow$ we-pass-the-law]]

(38) A function f is a choice function (CH(f)) if it applies to any non-empty set and yields a member of that set. (Reinhart, 1997: 372)

Therefore, we assume the tree in (39) for the DP in example (23) above, and its meaning is derived as in (40). This accounts for the resulting inherently definite interpretation of this DP.

(39)


(40) [[DP2]] = $\exists$f[CF(f) $\wedge$ f(λy. y = ιx[man-who-danced(x)]), defined iff $\exists$!x[man-who-danced(x)]

To sum up, in this section an analysis of *nó* in relative clauses was provided which accounts for its interpretation as an NP-determiner. The so-called definite interpretation of bare NPs and the co-occurrence of *nó* with the indefinite determiner *bí* were accounted for as well. The following section discusses a further 'clausal' determiner *nó* and argues that the analysis presented here for RC-*nó* cannot be extended to it.

4. Cleft-nó

As has already been discussed in Section 1, clause-final *nó* surfaces in different kinds of embedded constructions in Akan. Thus, although we have shown that RC-*nó* is not an event determiner, there are other candidate constructions for such an event/clausal determiner analysis. A good potential candidate is cleft-*nó*, as in the formal literature different cleft constructions cross-linguistically have been linked to definite descriptions. For example, Larson (2003) analyzed Fɔngbe clausal determiner as a quantificational adverb ('thely'), Renans (2016b, a) put forward an analysis of cross-categorical definite determiner *lɛ* in Gã (Kwa) as conveying the information that a discourse referent (an NP-entity or an event) is familiar and unique in bearing the property in question, Hole (2011) proposed that *de* in Mandarin Chinese *shi...de* clefts is an event determiner working on the presuppositional level and Onea (2011) proposed that the Hungarian focus structure introduces an event determiner-like operator. Also in the previous literature on Akan, cleft-*nó* has been informally described as marking the event of the embedded clause as familiar or presupposed (e.g., Saah, 1994; Ofori, 2011; Boadi, 1974).

Following these ideas, we aimed at testing whether the analysis of cleft-*nó* as introducing a definite interpretation of the event is sustainable.

4.1. Event definiteness

One problem with testing for event definiteness in Akan is that Akan clefts without *nó* already trigger an existence presupposition, as demonstrated in (41) and evidenced for example by (42), which in turn entails (weak) familiarity of the event (Grubic et al., 2019):

(41) Kofi nà ɔ̀-sá-àyɛ́ (**nó**).
Kofi PRT 3SG-dance-PST NO
'It's Kofi who danced.'
⇝ *Somebody danced* EXISTENCE PRESUPPOSITION

(42) Q: Who did Kofi invite to the party?
A: #ɛ̀-ǹ-yɛ́ **òbíárá** nà. ò-frɛ́-èɛ́
3SG.INA-NEG-be everybody PRT 3SG-invite-PST
'It was NOBODY that he invited.'

Since (weak) familiarity is already introduced by the cleft structure, we tested whether cleft-*nó* marks an event as unique, another dimension that was proposed to characterize the semantic contribution of definites. Under a 'naive' approach to event uniqueness, *nó* would indicate that there was only one event of the given type in the context. This 'naive' uniqueness seemed to be borne out in elicitation, as shown in (43), but it was not confirmed empirically in a larger written questionnaire conducted with six Akan native speakers in Accra.

(43) Context: At yesterday's party only Jojo danced: he danced to one song at the beginning of the party, one song at midnight, and one in the morning:
Jojo nà ɔ̀-sá-àyɛ́ (#**nó**).
Jojo PRT 3SG-dance-PST DEF
'It was JOJO who danced.'

In the previous literature on definite event determiners, it has been observed that they interact with Aktionsart and/or grammatical aspect. For example, an event determiner in Fɔngbe requires a telic predicate (Larson, 2003) or an accomplishment (Lefebvre and Brousseau, 2002) and in Gã, the cleft-definite determiner in imperfective sentences is incompatible with a habitual interpretation as it invariably enforces a progressive reading (Renans, 2016b).

Looking at Akan, while the language consultant's comments to the test in (44) indicates a possible influence of tense/aspect on the acceptability of *nó*, the data in (45) show that cleft-*nó* is accepted both with atelic predicates, e.g. activities, and habituals. Moreover, a larger written questionnaire did not reveal any interplay between the aspectual interpretation of the sentence and the acceptability of cleft-*nó*.

(44) A: I think Nana is happy at this stage in life.
B: Dààbí, Kofi nà n'àní gyé **(#nó)**.
No Kofi PRT 3SG.POSS.eyes receive NO
'No, it's KOFI who is happy.'
Comment: *With 'no' it makes it more present, quick instance of happiness.*

(45) Context: Amma is a writer. Your friend asks *Is it John who writes?*
Dààbí, ɛ̀yɛ̀ Amma nà (ɔ̀)twérɛ́ **(no)**.
No 3SG-be Amma PRT 3SG-write NO
'No, it's AMMA who writes.'

Thus we didn't find any evidence suggesting that cleft-*nó* marks an event as unique.

4.2. Comparison of Cleft-*nó* and NP-*nó*

Cleft-*nó*, unlike RC-*nó*, also does not mark NP uniqueness of the pivot, as illustrated in (46).[11] Cleft-*nó* is acceptable in (46) even though the pivot is indefinite and thus NP-*nó* cannot occur in the pivot of the cleft in (46):

(46) Context: Bediako and Ayawa are discussing [a fist fight that broke out on TV between politicians who had] sat around one table [with] several chairs around it. [...] Ayawa says to Bediako, while discussing:
A: Kwasi was fighting like a madman. I think that he broke the table during the fight.
B: Dààbí, ɛ̀-yɛ̀ **àkònnwá (bí)**/(**#nó**) nà ɔ̀-bú-ùyɛ̀ **(nó)**.
no 3SG.INA-be chair INDF/DEF PRT 3SG-carry-PST NO
'No, it was A CHAIR that he broke.'

However, it seems that in order to felicitously use cleft-*nó*, the focused individual in the pivot must be prementioned or mutually known, as shown by our elicitation data in (47).

(47) Context: You and your friends went on a holiday together. You are telling your sister that every friend picked a different sport to do during this holiday, e.g. jogging, climbing and swimming. Your sister asks you *So, who swam?* You say:

[11] Note also that *cleft-nó* doesn't mark the background as definite/unique either. Percus (2006) proposed for English clefts that the background is underlyingly definite, e.g. *It was a chair that he broke* ≈ *The thing he broke was a chair*. Under this analysis, the definiteness of the background is the source of the exhaustivity/existence inferences of clefts. However, all clefts in Akan give rise to these inferences, regardless of whether *nó* is present or absent, suggesting that the determiner is not responsible for them (Grubic et al., 2019).

ɛ̀-yɛ̀ Kofi nà ɔ̀-dwáré-èyɛ́ (**#nó**).
3SG-be Kofi PRT 3SG-swim-PST NO
'It was KOFI who swam.'
Comment: *'no' is good in a context where you have already talked about Kofi but [the addressee] didn't realise that he's the same person who swam.*

This observation fits in with other comments suggesting that a context in which the alternatives are listed ('Who out of ...?') is better than typical cleft contexts (e.g., corrections), as in (48):

(48) Context: You are telling your colleague that another colleague of yours went to Spain. He asks you: *So who is this guy who went to Spain?* You answer:
ɛ̀-yɛ̀ Kofi nà ɔ̀-kɔ́-ɔ̀ Spain (#**nó**)
3SG-be Kofi PRT 3SG-go-PST Spain NO
'It was KOFI who went to Spain.'
Comment: *If there are more [people, opposed to Kofi] it's ok. Which of them? Then you can add the 'no'*

To sum up, the data show that cleft-*nó* does not encode uniqueness of the event: it doesn't give rise to the interpretation that there is one unique event in the context and it does not show any interaction with temporal and aspectual interpretation of the sentence (neither with lexical nor with grammatical aspect). Cleft-*nó* also does not encode the definiteness of the pivot, in a way that RC-*nó* does. However, it possibly might encode givenness/contrastiveness of pivot, which forms our current hypothesis that is to be tested in our future research.

5. Summary

Clause-final determiners often receive a unified analysis as event determiners in the literature. We have argued against a unified analysis of these constructions in Akan by showing that the semantic contribution of the clause-final determiner in relative clauses (RC-*nó*) and that in clefts (cleft-*nó*) differ from each other. In particular, we have shown that RC-*nó* is actually a variant of the standard NP-determiner: first, both encode uniqueness of the DP referent, and second, apparent counterarguments to this analysis—optionality of *nó*, co-occurrence with the indefinite *bí*—apply to both the relative clause determiner and the NP-determiner. For clefts, on the other hand, we have shown that the clause-final determiner does not operate at NP level. Clause-final determiners in Akan are thus not a homogeneous group. It is important to examine the different instances of these constructions separately in order to determine their semantics.

Additionally, the cleft data provide evidence for cross-linguistic variation between different kinds of clausal determiners in clefts, see e.g. Gã clausal determiners, which mark events as definite, as evidenced by their interaction with TAM-marking (Renans, 2016a; Grubic and Renans, 2016, see also Fɔngbe, Larson, 2003), and Ngamo clausal determiners in focus constructions, which mark the topic situation as definite (Grubic and Renans, 2016; Grubic, 2015).

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P-HYPE: A monadic situation semantics for hyperintensional side effects[1]

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Abstract. P-HYPE is a hyperintensional situation semantics in which hyperintensionality is modelled as a 'side effect', as this term has been understood in natural language semantics, Charlow (2014); Shan (2007), and in functional programming. We use monads from category theory in order to 'upgrade' an ordinary intensional semantics to a possible hyperintensional counterpart. Hyperintensional side effects are analysed as a special type of perspective sensitivity. We combine Asudeh and Giorgolo's (2016) perspective sensitive semantic theory with a hyperintensional situation semantics, HYPE (Leitgeb, 2018), a logic with connections of Barwise and Perry's (1983) situation semantics, truthmaker semantics (Fine, 2017) and data semantics (Veltman, 1985). P-HYPE builds on the account of Asudeh and Giorgolo (2016), by carving out a notion of perspectives as special sets of situations which can be combined together via a fusion relation. In addition, we are able to capture the utterer's perspective on other people's perspectives, a phenomenon that plays a role in Asudeh and Giorgolo (2016) but which is not formally defined by them.

Keywords: Attitude verbs, monads, side effects, perspective, hyperintensionality, situation semantics.

1. Introduction

Semantic theories based on possible worlds that treat sentence meanings as sentence intensions (functions from worlds to truth values) have been plagued by the following problem since their inception (Hintikka, 1962; Montague, 1974): if, as presumably paradigm cases of necessary truths, we treat mathematical and logical truths as true in all worlds in every standard model, then they have the same intension (they are *intensionally equivalent*) in all standard models, and are thus logically equivalent–this despite the intuitive difference in meaning between certain mathematical and logical truths.[2] But consider (3) and (4) (see Cresswell, 1985: p.82), where 'the prime numbers' denotes the set of prime numbers:

(1) Kim proved that the prime numbers are infinite.

(2) Kim proved that the prime numbers are not inductive.

(3) The prime numbers are infinite.

(4) The prime numbers are not inductive.

In Cresswell (1985: p.82) a set is defined to be 'finite' iff it cannot be put into a one-one correspondence with a proper subset of itself, and a set is 'inductive' iff it can be put into a one-one correspondence with a proper initial segment of the natural numbers.[3] Given the assumption that the axioms of Zermelo–Fraenkel set theory with the axiom of Choice (ZFC) are true in all worlds of every standard model, (1) and (2) have the same intension, as do (3)

[1]We thank Carolyn Jane Anderson, Ash Asudeh, Chris Barker, Timothée Bernard, Reuben Cohn-Gordon, Patrick Elliott, Greg Kobele, Michael Mendler, Daniel Rothschild, and audiences at *Sinn und Bedeutung 23*

[2]We understand 'logically true/equivalent' or 'intensionally equivalent' with respect to classical logic. Later, when discussing HYPE we may if necessary refer to HYPE logical truths and equivalences.

[3]Readers may be more familiar with the terms 'Dedekind finite' for the former term and 'finite' for the latter (Cameron, 2012).

and (4), since the inductive sets and the finite sets are provably equivalent in ZFC.[4] But (1), (2) intuitively differ in meaning, as do (3) and (4).

So-called 'hyperintensional' semantic theories allow us to block substitution of intensionally equivalent sentences (see Fox and Lappin, 2008 and references therein). But there are two troubling features of contemporary discussions of hyperintensionality.[5] First: whilst hyperintensional logics abound, compositional accounts of how hyperintensionality works at the subsentential level are not always provided as a matter of course (Jago, 2014; Fine, 2017; Yablo, 2014). In some compositional accounts (Muskens, 2007; Pollard, 2015), it is not entirely clear what identity criteria for hyperintensional semantic values are assumed and furthermore, the subjective element of meaning (Haas-Spohn, 1995) that agents attach to co-intensional predicates is not captured.[6] Second: hyperintensional semantic theories generally focus on mathematical and logical truths embedded under attitude verbs, and often (Égré, 2014; Cresswell, 1985; Jago, 2014) don't transparently and straightforwardly apply to unembedded mathematical and logical truths, such as (3) and (4) above, even though they intuitively differ in meaning.

The intuition behind P-HYPE, which extends HYPE (Leitgeb, 2018) to the subsentential level, is that logically equivalent sentences sometimes differ in meaning relative to the perspective of interlocutors or agents. Developing the account of Asudeh and Giorgolo (2016) ('AG' from now on), attitude verbs thus require the constituents of their complement sentences to be interpreted from a particular perspective, and shifts in perspective are determined pragmatically via the context of utterance, much as in certain hyperintensional semantic theories in Cresswell and Von Stechow (1982) and Égré (2014) in which hyperintensionality is modelled by means of *de re* interpretations and it is up to pragmatics to select an appropriate *de re* reading.[7] In addition, a special designated perspective, the *enlightened* perspective allows constituents to receive their ordinary intensional interpretation. Monads enter the picture by allowing us to include perspective sensitive semantic values without revision of compositional rules. However, they offer an additional, compelling lens with which to view hyperintensionality itself, as a 'side-effect' of semantic computations.

In section **2** we propose to analyse hyperintensionality as a side effect, and then discuss (**2.1**) Asudeh and Giorgolo's (2016)'s semantic theory. In section **3** we introduce HYPE (**3.1**) and P-HYPE (**3.2**). We then discuss some toy lexical entries (**3.3**), before giving an example of how P-HYPE analyses (**3.4**) hyperintensionality. Finally (**3.5**) we discuss how our semantics might deal with unembedded mathematical/logical truths.

2. Hyperintensionality as a side effect

To capture certain linguistic phenomena compositionally, non-deterministic, intensional or state-changing operators are introduced (Charlow, 2014), in addition to extensions. Shan (2002)

[4]This example could, of course, be replaced by any other example on which two mathematical predicates are necessarily co-denoting, and which does not involve the assumption that the axioms of ZFC are valid in every model.

[5]We restrict our discussion throughout to hyperintensionality in natural language semantics and ignore other domains in which the concept may be applicable.

[6]Greg Kobele points out that certain algorithmic accounts of hyperintensionality (Moschovakis, 2006; Muskens, 2005) might be able to model certain forms of subjectivity as differences between reduction sequences that are acceptable to different agents.

[7]However, the pragmatics of these perspective shifts will not be studied in this paper.

had the intuition that we can model many of these phenomena–which might naively seem non-compositional–as 'side effects' of computing the main value of an expression. Shan (2007) includes amongst so-called linguistic side effects certain types of referential opacity and certain expressions whose meaning and compositional contribution is not pre-theoretically transparent. Hyperintensionality is arguably a good example of a linguistic side effect, since it is not clear what distinction to make between the semantic contribution of logically equivalent statements, how their meanings relate to their truth conditions, and how to characterise their behaviour compositionally. But from both Charlow (2014) and Shan's list of linguistic side effects, hyperintensionality is conspicuous by its absence. We propose that hyperintensionality be added to the list of linguistic side-effects, and try to study it from this vantage point.[8]

Monads have been used to model linguistic side effects (see Giorgolo and Unger, 2009; Van Eijck and Unger, 2010; Asudeh and Giorgolo, 2012; Unger, 2011; Charlow, 2014; Barker and Shan, 2014; Bumford, 2015; Charlow, 2017) and, in particular, to obviate continual revision of compositional rules, as different types of semantic value are added to a semantic theory (for motivation along these lines, see Shan, 2002 and Charlow, 2014). Monads map operations and values in a given type-space with operations and values in an enriched type-space (which might include such exotic semantic values as intensions, focus-sensitive and judge-sensitive semantic values) whilst preserving ordinary extensional function application as the main compositional principle and without generalising to the worst case. Normally, to compositionally combine intensions we need intensional function application (Heim and Kratzer, 1998), in addition to extensional function application. Monads allow us to do forego this additional compositional rule.

Both P-HYPE and the semantics of AG, enrich the typed lambda calculus with a reader monad (Shan, 2002) defined on P, the set of perspective indices. We will discuss how perspective indices are employed later. For now we can just say that to every agent in a discourse there corresponds a perspective index, and that certain terms which are perspective sensitive are interpreted relative to perspective indices. If an expression has type α, a perspectivally sensitive expression has type $P \to \alpha$. The reader monad is a triple $(\Diamond, \eta, \bigstar)$. $\Diamond : \mathit{TYPE} \to \mathit{TYPE}$, is a type-constructor, which behaves as a special modal operator in Lax logic (Fairtlough and Mendler, 1997).[9] $\Diamond$ maps any type τ to $P \to \tau$ and, for all a, b, maps a function $f : a \to b$ to a function $\Diamond f : \Diamond a \to \Diamond b$, such that $(\Diamond f)(x) = \lambda i.f(xi)$.[10] $\eta : \tau \to \Diamond\tau$ is a value-constructor that takes a non-monadic value $x : \tau$ and trivially upgrades it to monadic values by forming a constant function from perspective indices to x. It is called the *unit* of the monad:

Definition 1 : $\eta(x) =_{def} \lambda i.x : P \to \alpha$

Finally, $\bigstar$ (called *bind*) is a polymorphic binary infix operator acting as a sort of functional

[8]The null hypothesis would be that hyperintensionality is a phenomenon which exhibits one sort of side-effect as opposed to a multiplicity of side effects. This hypothesis is not invalidated by the the idea (p.c Daniel Rothschild), that there is not a single phenomena of hyperintensionality for which we need to go beyond or develop the resources of standard intensional framworks, but rather a number of different cases, lumped together as 'hyper-intensional'. A uniform account of these often-lumped-together cases as exhibiting a certain kind of side effect, might actually reveal certain interesting commonalities between the cases.

[9]It is in fact an endofunctor, as this is understood in Category theory; that is, a functor that maps a category to itself (in this case the category of types).

[10]Throughout '$x : \alpha$' is read 'x is of type α'.

application:

(5) $\bigstar$ ('bind'): $\Diamond \to (\tau \to \Diamond\delta) \to \Diamond\delta$

Definition 2 : $a \bigstar f =_{def} \lambda i.f(a(i))(i)$ where $a : \Diamond\tau, f : \tau \to \Diamond\delta$

We will present $\bigstar$ as a type-shifting operation as in (6), which shifts something of type $\Diamond\alpha$, to a generalised quantifier of type $(\alpha \to \Diamond\beta) \to \Diamond\beta$ which is then able to take a predicate abstract of type $\alpha \to \Diamond\beta$ as argument. The η operator instead will be presented via a non-branching tree (see (7)):

(6)

$$y\bigstar\lambda x.t : \Diamond\beta$$

$$y^{\bigstar} : (\alpha \to \Diamond\beta) \to \Diamond\beta \qquad \lambda x.t : \alpha \to \Diamond\beta$$

$$\Big| \bigstar$$

$$y : \Diamond\alpha$$

(7)

$$\eta(x) : \Diamond\alpha$$

$$\Big| \eta$$

$$x : \alpha$$

2.1. AG's semantic theory

AG aim to model the behaviour of co-referring names in attitude reports via a special form of perspective relativity. Consider the sentence (8a), uttered in the scenario (8b)

(8) a. Mary Jane loves Spiderman.
b. *Scenario:* Mary Jane does not know Peter Parker's secret identity and loves the man she calls 'Peter Parker'. A speaker σ who knows or is 'enlightened' (Zimmermann, 2005) about Peter Parker's secret identity utters (8a)

According to AG, there is a sense in which (8a) is true, from the perspective of an enlightened utterer, but false from Mary Jane's perspective. (Asudeh and Giorgolo, 2016) model this by making certain names perspective relative, so that Mary Jane can associate a distinct denotation with the names 'Spiderman' and 'Peter Parker'. Thus names denote certain people's mental representations, which they call perspectives. We can then imagine a sort of private mental lexicon for each person, consisting of the set of perspectives that a given person associates with terms of her language, which we call that person's perspective or their mental model. We use 'perspective' ambiguously–both to denote a semantic value in someone's mental model, and that person's mental model–with the context serving to disambiguate which notion we have in mind. Consider the lexicon (**Table 1**) of the enlightened speaker σ of (8a). Plain names are subscripted with σ to indicate that this is the denotation of that name for σ. The names which are type $\Diamond e$ have different denotations, depending on what perspective index they are interpreted relative to. AG suppose that certain names vary in perspective but others do not. Those which do not vary in perspective have something like a default status, in the following sense: if someone becomes enlightened, and learns, for example that Spiderman and Peter Parker are one and the same thing, then they will, by and large, just use plain 'Peter Parker', and this name will thence have default status, with 'Spiderman'. Notice the κ operator in the

WORD	DENOTATION	TYPE
Mary Jane	$\mathbf{mj}_\sigma$	e
Peter Parker	$\mathbf{pp}_\sigma$	e
believe	$\lambda c.\lambda s.\mathbf{B}(s, c(\kappa(s)))$	$\Diamond t \to e \to t$
love	$\lambda o.\lambda s.\mathbf{love}(s, o(\kappa(s)))$	$\Diamond e \to e \to t$
Spider-Man	$\lambda i.\begin{cases}\mathbf{sm}(\mathbf{i}) & \text{if } i = \kappa(mj)\\ \mathbf{pp}(\mathbf{i}) & \text{if } i = \kappa(\sigma)\end{cases}$	$\Diamond e$

Table 1 Lexicon of σ, the enlightened speaker

denotation of *believe* and *love*. κ has the following interpretation (where D_e is the domain of individuals of a model):

(9) $\forall x \in D_e\ (\kappa(x) \in P)$

Perspective sensitive expressions that scope below κ are interpreted relative to the perspective index corresponding to the subject of the attitude report (see **Table 1**). Expressions that scope above $\bigstar$, are interpreted relative to the default perspective of the utterer. Let us consider the two readings of (8a).

The false reading of (8a) is represented by (10),which β-reduces to (11), and the true reading is represented by (12), which β-reduces to (13):

(10) $$love(mj_\sigma, \lambda i.\begin{cases}\mathbf{sm}(\mathbf{i}) & \text{if } i = \kappa(mj)\\ \mathbf{pp}(\mathbf{i}) & \text{if } i = \kappa(\sigma)\end{cases}(\kappa(mj)))$$

(11) $love(mj_\sigma, sm(\kappa(mj)))$

(12) $$\left(\lambda i.\begin{cases}\mathbf{sm}(\mathbf{i}) & \text{if } i = \kappa(mj) : P\\ \mathbf{pp}(\mathbf{i}) & \text{if } i = \kappa(\sigma) : P\end{cases} \bigstar \lambda z.\eta\,(love(mj, z)))\right)(\kappa(\sigma))$$

(13) $love(mj_\sigma, sm(\kappa(\sigma)))$

Since *Spiderman* in (12) scopes above $\bigstar$ and above κ, it is interpreted relative to the default perspective index, which is the index of the speaker, who they assume in their model to be enlightened. They thus stipulate that the speaker's perspective is the one fed to an expression of the form $a\bigstar f$, which by definition denotes $\lambda i.f(a(i))(i)$, and thus, if the speaker's index is j, we always evaluate some expression of the form $a\bigstar f$ at j.[11] When, however, a perspective

[11] The technical stipulation they make is grounded in certain claims about perspective relativity, such as the claim that sentences or expressions which are perspective relative are usually relative to the perspective of the utterer of them, and if they are relative to other perspectives, they are relative either to individuals salient in some group within a given context, or are relative to the perspective of the subject of the sentence. We won't assess these claims here, but suffice to say that they have been discussed and broadly endorsed by researchers working on

relative expression scopes below the function f in $a\bigstar f$, it is caught by the κ operator.

AG make a certain assumption not reflected in their formalisation: that the utterer of (8a) never *really* interprets *Spiderman* from Mary Jane's perspective, since it is only really accessible to her. Rather, in this case, the denotation of *Spiderman* for the utterer is something in the perspective of the utterer which represents what the utterer takes to be the denotation of the expression relative to the perspective of Mary Jane. And, in general, according to AG, an expression occurring in a sentence only really ever receives a denotation in the mental model of the utterer of that sentence. Whatever the strengths of this assumption, one feature of P-HYPE is that we are able to capture their idea formally, or abandon it entirely, if desirable.

3. P-HYPE: a combination of HYPE and monads

3.1. HYPE

HYPE (Leitgeb, 2018) is a logic which employs states/situations.[12] States may be like classical possible worlds, but may also be partial (or *gappy*)–verifying neither a formula nor its negation–and inconsistent (or *glutty*)– verifying a formula and its negation. One nice feature of HYPE is that it behaves entirely classically at a subset of states; as such, linguistic analyses couched in classical logics can be transferred to HYPE. The language of First order HYPE is that of Classical Predicate logic: a countably infinite set of individual variables x, x', x'''... and predicates of finite arity P, P'..., alongside the logical symbols $\forall, \exists, \neg, \wedge, \vee, \supset, \top$. But HYPE incorporates special incompatibility $\perp$ and fusion operators $\circ$ in the satisfaction clauses for negation and the conditional, somewhat like Veltman (1985: pp. 202–7) and truthmaker semantics.

A First-order HYPE model is a structure $\mathfrak{M} = \langle S, D, V, \circ, \perp \rangle$, such that:[13]

- $S \neq \emptyset$ is a set of states or situations. $S = S_c \uplus S_n$, where S_c, S_n are the set of classical and nonclassical states, respectively, where a nonclassical state is a glutty or gappy state.
- $D \neq \emptyset$ is the domain of individuals. We can define the local domain of a world if necessary (Leitgeb, 2018).
- $V : S \mapsto \mathscr{P}(SoA)$ is a valuation function from S to the power set of the set of states of affairs, where SoA is defined as follows:

  Definition 3 The set of states of affairs, SoA, relative to a given domain D and vocabulary, is the set of all tuples $P(d_1, ..., d_n)$ and $\overline{P}(d_1, ..., d_n)$, where P is an n-ary predicate $(n \geq 0)$ such that $\overline{P}$ is its negation, $P = \overline{\overline{P}}$ and each $d_i \in D\, (1 \leq i \leq n)$.

- $\circ$ and $\perp$ are the fusion and incompatibility operators, respectively, such that:
  1. $\circ : S \times S \to S$ is a partial commutative, associative binary function (called *fusion*), such that:
     - Either $s \circ s'$ is undefined, or $s \circ s'$ is defined (and hence in S) in which case it is required that $V(s \circ s') \supseteq V(s) \cup V(s')$.

perspective relativity.

[12] We will use the words 'states' and 'situations' interchangeably.

[13] HYPE also incorporates a special star operator. See (Leitgeb, 2018) for more details.

- $s \circ s$ is defined, and $s \circ s = s$.

2. $\perp$ is a binary symmetric relation on S (the incompatibility relation), such that:
   - If there is a v with $v \in V(s)$ and $v \in V(s')$, then $s \perp s'$.
   - If $s \perp s'$ and both $s \circ s''$ and $s' \circ s'''$ are defined, then $s \circ s'' \perp s' \circ s'''$.

$\circ$ gives rise to a partial order $\leq$, such that, for all $s, s' \in S$, $s \leq s'$ iff $s \circ s'$ is defined and $s \circ s' = s'$. Importantly, truth is monotonic under fusion extension: for all s, if $s \models A$ and $s \circ s'$ is defined, then $s \circ s' \models A$.

Variable assignments ρ and their modified variants $\rho(d/x)$ behave as in Classical Predicate logic. Satisfaction of a formula ϕ is defined relative to a state and a variable assignment (written: $s, \rho \models \phi$), and the clauses for the logical symbols are as usual, except for $\neg$ and $\supset$, which have a distinctly modal flavour: $s, \rho \models \neg A$ iff for all s' : if $s' \models A$ then $s \perp s'$ and $s, \rho \models A \supset B$ iff for all s' : if $s' \models A$ and $s \circ s'$ is defined, then $s \circ s' \models B$.

3.2. Introducing P-HYPE: a combinination of HYPE and AG's perspective-sensitive semantics

In P-HYPE, we require the usual hierarchy of typed domains familiar from (Gallin, 1975), whose elements correspond to different kinds of entities. To this end, let $TYPE$ be the smallest set such that:

1. $e, t, P \in TYPE$

2. If $\alpha, \beta \in TYPE$, then $\alpha \to \beta \in TYPE$

Let a frame based on D and $\mathscr{P}(S)$ be a set $\mathscr{D} = \{D_\alpha \mid \alpha \in TYPE\}$ such that $D_e = D, D_t = \mathscr{P}(S)$, $D_P = P$ and $D_{\alpha \to \beta} \subseteq \{f \mid f : D_\alpha \to D_\beta\}$ for each type $\alpha \to \beta$. The basic idea behind P-HYPE is that we add a set P of perspective indices, relative to which perspective sensitive expressions are interpreted. These are in the image of a function, $\kappa : D_e \times S \mapsto P$, much like AG's κ function, which assigns perspective indices to agents at states. We then provide a function $\pi : P \times S \to \mathscr{P}(S)$ which maps perspective indexes and states to a set of states which we call the *perspective set (p-set) of an agent* at that state (this is the *perspective* or *mental model* of the agent, in the sense discussed above). Following AG, we can then, if we desire, enforce the distinctness requirement amongst perspectives they impose by requiring that the perspective set of two distinct agents is always distinct. This models their intuition that perspectives are entirely private. The semantic values of perspective-sensitive expressions then pick out subsets of the perspective set of agents. In this sense a name and predicate denotation interpreted relative to a perspective is something which only inhabits that perspective.

Let VAR_α, and CON_α be countably infinite sets of variables and constants, for each $\alpha \in TYPE$, and let $\{\rho_\alpha \mid \rho_\alpha : VAR_\alpha \to D_\alpha \}$, for all $\alpha \in TYPE$ be the set of assignments. The semantic value $V_\rho(A_\alpha)$, of A_α with respect to assignment ρ in a model $\mathfrak{M}$ is then defined so as to include quantification at all levels of the type-hierarchy and clauses for both function application and lambda abstraction:

- $V_\rho(x : \alpha) = \rho(x : \alpha)$

- $V_\rho(c : \alpha) \in D_\alpha)$
- $V_\sigma(\forall x : \alpha\, A) = \bigcap_{d \in D_\alpha} V_{\sigma(d/x)}(A)$
- $V_\sigma(\exists x : \alpha\, A) = \bigcup_{d \in D_\alpha} V_{\sigma(d/x)}(A)$
- $V_\sigma(A_{\alpha\to\beta} B_\alpha) = V_\sigma(A_{\alpha\to\beta}) V_\sigma(B_\alpha)$
- $V_\sigma(\lambda x_\alpha A_\beta) =$ the function f on D_α whose value at $d \in D_\alpha$ is equal to $V_{\sigma'} A_\beta$, where $\sigma' = \sigma(d/x)$
- $V_\sigma(A_\alpha \equiv B_\alpha) = \{s \mid V_\sigma(A_\alpha) = V_\sigma(B_\alpha)\}$

A *P-HYPE* model is a structure $\mathfrak{M}_1 = \langle S, \mathfrak{D}, \kappa, P, E, V, \pi, \circ, \perp\rangle$, such that:

(i) $\mathfrak{D} = \bigcup_{\alpha \in \mathscr{D}} D_\alpha$

(ii) $\langle S, \mathfrak{D}, V, \circ, \perp\rangle$ is a HYPE model.

(iii) $\kappa : D_e \times S \mapsto P$, is a function that associates a unique perspective index $\kappa(d,s)$ to each individual d in a state s.

(iv) P is a set of perspective indices generally of the form $\kappa(d,s)$, for $d \in D_e$, $s \in S$.

(v) $E \in P$ is a distinguished isolated perspective index such that $\neg(\exists x \in D_e, s \in S.(\kappa(x,s) = E))$

(vi) $\pi : P \times S \mapsto \mathscr{P}(S)$ maps every perspective index $\kappa(d,s) \in P$ and state $s \in S$ to a set of states $\pi(\kappa(d,s),s) \subseteq S$, the *perspective set* or p-set of d at s. When d_i is enlightened then $\pi(\kappa(d,s),s) = \{s\}$. Moreover, to ensure monotonicity of truth under $\leq$, if $s \leq s'$ then $\pi(\kappa(d_i,s),s) \leq \pi(\kappa(d_i,s),s')$, where $S \leq S'$ is defined by the condition $\forall s' \in S'.\exists s \in S.\, s \leq s'$.[14]

(vii) For any $d_i \in D_e$ at state s, we can define a HYPE-model $\langle \pi(\kappa(d_i,s),s), D, V, \circ, \perp\rangle$, whose set of states is the p-set of d_i at s.

(viii) For all $d_1, d_2 \in D_e$ for which $d_1 \neq d_2$, and all $s \in S$, $\pi(\kappa(d_1,s),s) \cap \pi(\kappa(d_2,s),s) = \emptyset$. This condition ensures that perspectives and the denotations of expressions relative to perspectives, are entirely subjective and do not overlap with one another.

Let us consider some aspects of P-HYPE models. π allows us to collect together states that contain the private denotations of words for a given agent. These states may in turn be fusions of other states, or they may be atomic. There are various ways we might think of the fusion of states in a perspective. One is to construe them as collections of states such that the propositions true at these states are about some subject matter. Another is to think of them as collections of situations which store information about certain discourse referents, and to think of $\circ$ as a way of transitioning to states with different discourse referents. However, other than the property of monotonicity, which is preserved under fusion extension in the logic HYPE, we leave open for further research what exact role fusion might have in the perspective of an agent. Thus, whilst we left open what the perspective of an agent is, we have come up with a proposal which we will explore further elsewhere. It might even be the case that via P-HYPE we can simulate different theories of hyperintensionality.

[14] Truth is monotonic under with respect to $\leq$ in HYPE.

WORD	DENOTATION	ABBREVIATION
Spiderman	$\lambda i.\begin{cases} sm(i) & \text{if } \exists s \in S.\ i = \kappa(h,s) \\ pp(i) & \text{else } \exists s \in S.\ i = E \end{cases} : \Diamond e$	*spiderman*
Inductive	$\lambda x, \lambda j.\begin{cases} I(j)(x(j)) & \text{if } \exists s \in S.\ j = \kappa(h,s) \\ finite(j)(x(j)) & \text{else } \exists s : S.\ j = E \end{cases} : \Diamond e \to \Diamond t$	*inductive*
Love	$\lambda y, x, i..\{ s \mid \forall s'[s' \in \pi(i,s) \supset s' \in Love(x, y(\kappa(x,s')))]\} : \Diamond e \to e \to \Diamond t$	*love*
Believe	$\lambda p, x, i.\{ s \in S \mid \forall s'[s \leq s' \wedge s' \in \pi(i,s)] \supset \forall s''$ $[DOX(x, s \circ s', s'') \supset s'' \in p\ (\kappa(x,s''))]\} : \Diamond t \to e \to \Diamond t$	$\lambda p, x, i.bel(i, x, p(\kappa(x,s'')))$
Prove	$\lambda p, x, i.\{ s \in S \mid \forall s'[s \leq s' \wedge s' \in \pi(i,s)] \supset \forall s''$ $[PROV(x, s \circ s', s'') \supset s'' \in p\ (\kappa(x,s''))]\} : \Diamond t \to e \to \Diamond t$	$\lambda p, x, i.prove(i, x, p(\kappa(x,s'')))$
the primes	$\lambda i.\iota x : prime.number(x(i)) : \Diamond e$	*the.primes*

Table 2 Simplified lexical entries

3.3. Lexical entries and examples

There are four comments to make about these lexical entries in **Table 2**. Firstly, h denotes 'Harold' (who features in our examples), 'E' denotes the enlightened perspective and 'u' denotes the perspective index of the utterer of a sentence. The enlightened perspective index is the perspective index which, if supplied to an expression whose denotation takes a perspective index as an argument, returns the intension of that expression. Secondly, many of these lexical entries are simplified. For example, we are assuming (for expository simplicity) that *prove* is a guarded universal quantifier over worlds–though we haven't specified what sort of universal quantifier it is–and that *Prove* is factive, and so presupposes the truth of its complement.

Thirdly, a crucial aspect of the lexical entries for verbs, is that we are able to formalise the intuition of AG that such complements are always interpreted relative to a perspective which the utterer thinks is the perspective of another person. Consider the denotation of *believe*, which combines with a proposition of type $\Diamond t$ (i.e, a function from perspective indices to states to truth values), an individual and a perspective index. We assume that, in the case of propositional attitude verbs, this perspective index must always be the utterer's perspective index. Where u is the utterer's perspective index at state s, *Believe* then universally quantifies over both (i) all the states $s' \geq s$, such that $s' \in \pi(u,s)$, where s is the world in which the sentence is being evaluated and (ii) all the states s'' which are doxastically accessible from $s \circ s'$. x *believes* p is then true iff p is true in s'' relative to the perspective index associated with x at s''.

3.4. 'Prove' and the complements of attitude verbs

Consider (14) and (15):

(14) Harold proves that the primes are not inductive.

(15) Harold proves that the primes are infinite.

Using the lexical entries above, we can derive (16) for a sentence like (14) and (17) for a sentence like (15):

(16) $\{ s \in S \mid \forall s' [s \leq s' \wedge s' \in \pi(u,s)] \supset \forall s''[PROV(h, s \circ s', s'') \supset s'' \in \neg I(\kappa(h,s''))(\iota x.prime.number(x(\kappa(h$

(17) $\{ s \in S \mid \forall s' [s \leq s' \wedge s' \in \pi(u,s)] \supset \forall s''[PROV(h, s \circ s', s'') \supset s'' \in \neg finite(\kappa(h,s''))(\iota x.prime.number(x$

Crucially, (16) and (17) will differ in truth value, if Harold associates distinct denotations with *inductive* and *finite*.

We can also derive the following readings for (14):

(18) $\{ s \in S \mid \forall s' [s \leq s' \wedge s' \in \pi(E,s)] \supset \forall s''[PROV(h, s \circ s', s'') \supset s'' \in \neg I(E)(\iota x.prime.number(x(E)))] \}$

(19) $\{ s \in S \mid \forall s' [s \leq s' \wedge s' \in \pi(u,s)] \supset \forall s''[PROV(h, s \circ s', s'') \supset s'' \in \neg I(u)(\iota x.prime.number(x(u)))] \}$

(20) $\{ s \in S \mid \forall s' [s \leq s' \wedge s' \in \pi(u,s)] \supset \forall s''[PROV(h, s \circ s', s'') \supset s'' \in \neg I(u)(\iota x.prime.number(x(\kappa(h,s''))))$

(21) $\{ s \in S \mid \forall s' [s \leq s' \wedge s' \in \pi(u,s)] \supset \forall s''[PROV(h, s \circ s', s'') \supset s'' \in \neg I(\kappa(h,s''))(\iota x.prime.number(x(u)))$

(16) is derived via the tree in (22) below (we make free use of the abbreviations in **table 2**). In (22),'the primes' and 'inductive' remain *in situ* and we feed in the utterer's perspective index $u : P$ at the top of the tree (from now on we call this final perspective index at the top of the tree, the *top-level* perspective index). Consequently, these predicates are caught by the κ operator, and so we get the interpretation where the these expressions are interpreted in the way that the utterer thinks that Harold thinks they are interpreted:

(22)

- $\{\, s \in S \mid \forall s' [s \leq s' \wedge s' \in \pi(u,s)] \supset \forall s''[PROV(h, s \circ s', s'') \supset s'' \in \neg I(\kappa(h,s''))(\iota x.prime.number(x(\kappa(h,s''))))] \,\}$
  - $u : P$
  - $\lambda i.prove\,(i, h, not(inductive(the.primes))\,(\kappa(h,s'')))$
    - $h : e$
    - $\lambda x, i.prove\,(i, x, not(inductive(the.primes))\,(\kappa(x,s''))) : e \to \Diamond t$
      - $\lambda p, x, i.prove(i, x, p\,(\kappa(x,s''))) : \Diamond t \to e \to \Diamond t$
      - $not(inductive(the.primes))$
        - not
        - $inductive(the.primes) : \Diamond t$
          - $inductive : \Diamond e \to \Diamond t$
          - $the.primes : \Diamond e$

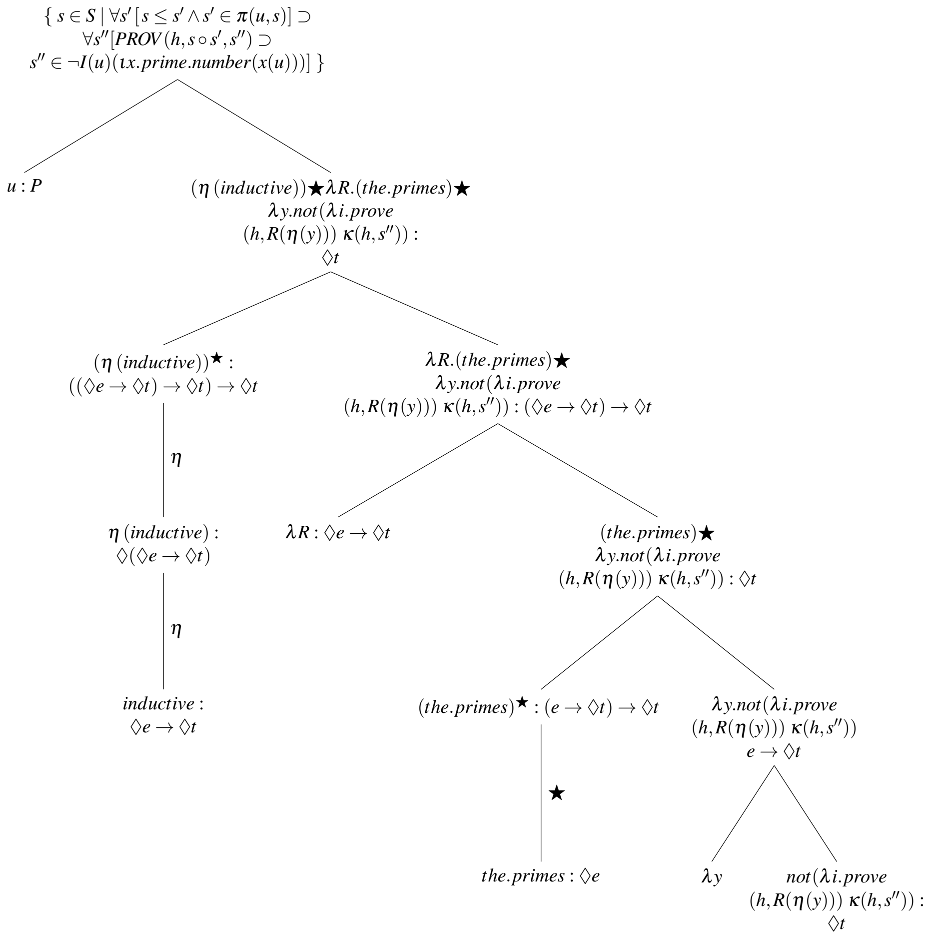
(18) is derived via the tree in (23) below. On this interpretation, (14) receives its usual intension, since we when supply the enlightened perspective index to an expression that expression has its ordinary intension as its semantic value. For this derivation we feed the enlightened perspective index to ‘the primes’ and ‘inductive’, using η to ensure that these functions can combine, and to ensure that ‘the primes are inductive’ is fixed to its ordinary intension before combining with ‘prove’. Then we feed in the enlightened perspective index as the top-level perspective index.

(23)

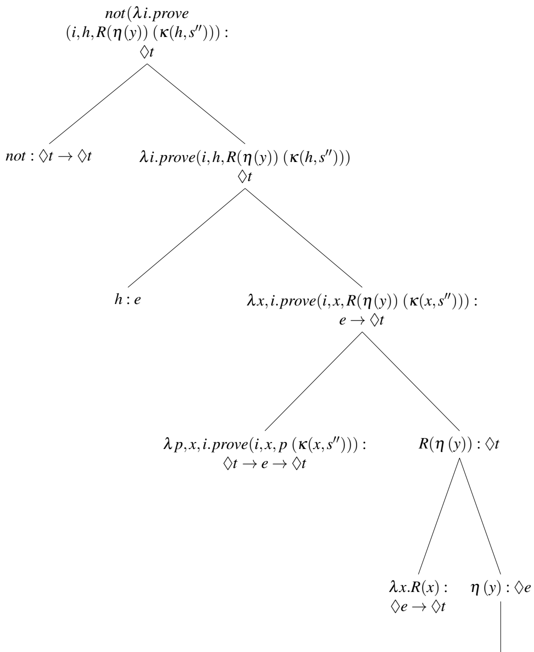
- $\{ s \in S \mid \forall s' [s \leq s' \wedge s' \in \pi(E,s)] \supset \forall s''[PROV(h, s \circ s', s'') \supset s'' \in \neg I(E)(\iota x.prime.number(x(E)))] \} : t$
  - E
  - $\lambda i.prove(i,h,not(\eta(Inductive(E)(the.primes(E))))(\kappa(h,s''))) : \Diamond t$
    - $h : e$
    - $\lambda x,i.prove(i,x,not(\eta(Inductive(E)(the.primes(E))))\,\kappa(x,s'')) : e \to \Diamond t$
      - $\lambda p,x,i.prove(i,x,p\,\kappa(x,s'')) : \Diamond t \to e \to \Diamond t$
      - $not(\eta(Inductive(E)(the.primes(E))))$
        - $not : \Diamond \to \Diamond t$
        - $\eta(Inductive(E)(the.primes(E))) : \Diamond t$
          - η: $Inductive(E)(the.primes(E)) : t$
            - E
            - $inductive(\eta(the.primes(E)))$
              - $\eta(the.primes(E))$
                - η: $the.primes(E)$
                  - E
                  - $the.primes$
              - $inductive : \Diamond e \to \Diamond t$

For readabiity, we represent the derivation of (19) by two trees: (24) (for the upper half of the tree) and (25) (for the lower half). (19) is the reading on which both 'inductive' and 'the primes' are interpreted from the utterer's perspective. This reading requires we scope both 'inductive' and 'the primes' above ★, so that they escape κ:

(24)



(25)



Expressions scoping above $\bigstar$ are evaluated relative to the utterer's perspective, and expressions scoping below are evaluated according the perspective index associated with the subject, and this allows us to generate 'mixed interpretations' in which some expressions in a sentence are evaluated at the utterer's perspective and others are not. But we don't want some expressions to be evaluated with respect to the enlightened perspective and others not, since it is not clear to us whether such contrasts correspond to valid interpretations of sentences. For this reason, whenever we use ★, the top-level perspective index that we feed to the sentence denotation must be the utterer's perspective index. We only use the enlightened perspective in one case: when all expressions in a sentence are to express their usual intensional values.

In cases where ★ is not used, the top-level perspective index can be either the enlightened perspective index or the utterer.

We use ★ to derive the readings in (19), (20) and (21).[15] But, to derive (19), we could have produced a tree isomorphic to (23) without ★, but in which the utterer's perspective index replaces every instance of the enlightened perspective index. Similarly, (20) and (21) could be derived without ★ with trees in which 'inductive' and 'the primes' remain *in-situ* under the denotation of *prove*, which we omit due to space constraints. So we might think ★ is unnecessary. If, however, we want the priviledged status of the utterer's perspective to be somehow indicated in the trees that we give for various sentences, one option is to require that the utterer's perspective on the interpretation of expressions in a sentence is only available if those expressions scope above ★, and that terms that scope above ★ are always interpreted relative to the utterer's perspective. If we choose this option, then we preserve one feature of the account of Asudeh and Giorgolo (2016), according to which perspectivally-sensitive expressions are somewhat like expressions which take wide-scope when interpreted *de re*. This might be a reason to suggest keeping ★, at least if we think this analogy between perspectivally-sensitive expressions and *de-re*, scoping expressions is significant.

One interesting group of cases which might be thought to pose a challenge to our account involves contrastive focus. Consider an utterance of (26b) in the scenario (26a) ($[\text{ e }]_F$ indicates that the expression 'e' has focus):

(26) a. *Scenario*: Harold and Bill are both enlightened about inductive and finite (i.e, they both know that the prime numbers are finite if, and only, if they are inductive) and it is mutual knowledge that they are both enlightened. Bill utters (26b) to Harold:

b. You proved the prime numbers are $[\text{ not finite}]_F$, not that the prime numbers are $[\text{ not inductive}]_F$.

In the scenario (26a), (26b) is felicitous. However, our semantics predicts that, if the utterer is aware of Harold's being enlightened, (26b) would be infelicitous, given the assumption that a speaker who is enlightened about two co-intensional expressions assigns them the same intension. The felicitous reading of this sentence is arguably (Chris Barker, p.c) a case of metalinguistic focus (Li, 2017), in which Bill is rejecting the use appropriateness of using 'not inductive' as opposed to 'not finite'. Such cases could be captured via the monad for metalinguistic focus (see Li, 2017).[16]

[15]Patrick Elliott (p.c) has asked whether in P-HYPE we need a monad, as opposed to an applicative. In a monad we have $\Diamond\Diamond A \equiv \Diamond A$. In an applicative we have $\eta : \alpha \to \Diamond\alpha$, but we do not have the 'join' $\mu : \Diamond\Diamond\alpha \to \Diamond\alpha$ of the monad, nor ★. We think certain perspective relative phenomena require μ, but don't have the space to discuss these here. The argument of this paragraph would also require ★, if correct.

[16]Perhaps (26b) in (26a) is also felicitous when another perspective, say the perspective of a listener who Harold

3.5. Unembedded mathematical and logical truths

We end by briefly considering how our account might extend to mathematical and logical truths which are not embedded under propositional attitude verbs. There are two sorts of problems we encounter. Firstly, if we allow predicates to be perspective relative across the board, it might seem we predict that sentences like (27) could be true relative to some perspectives, and therefore not plainly false:

(27) There are ten natural numbers.

This objection misunderstands what we mean by saying something is true relative to a perspective. To say this is simply to say that there exists a speaker whose whose mental model verifies the sentence because of the mental representations associated with its parts.[17] This is compatible with (27) being plainly false, and the truth/falsity *simpliciter* of a sentence is determined relative to the enlightened perspective index. We are not denying, unlike MacFarlane (2014), that certain sentences are true *simpliciter*. For us, (27) is strictly speaking false, however it is true (or coherent) relative to some bizarre perspective index, which is unlikely to be associated with all but the strangest of individuals, and unlikely to be salient in any context.[18]

Secondly, consider the seemingly infelicitous (28). (28) receives a coherent reading (30) on the perspective relative semantics (where *u* and *a* represent the perspective of the utterer of the sentence and of the audience), which might usually be expressed by a sentence like (29):

(28) ?The primes are not finite but the primes are finite.

(29) The primes are not finite but the primes are inductive.

(30) $\underbrace{\text{the primes}}_{u}$ are $\underbrace{\text{not finite}}_{u}$ but $\underbrace{\text{the primes}}_{a}$ are $\underbrace{\text{finite}}_{a}$

One response (Chris Barker, p.c) to this problem is that there is in fact a coherent, albeit pragmatically dispreferred/marginal reading of (28), but that in most cases we assess the sentence relative to some perspective on which *not finite* and *finite* are contradictory, perhaps because we usually take predicates in the same sentence to be interpreted from the same perspective. For this reason we would tend to prefer (29) to (28). In fact, Asudeh and Giorgolo (2016), consider a similar case contrasting (31) and (32):

(31) Mary Jane loves Spiderman, but she doesn't love Spiderman.

(32) Mary Jane loves Peter Parker, but she doesn't love Spiderman.

They observe that whilst there is a coherent reading of (31) in their semantics, (32) is preferable on pragmatic grounds to (31), namely, because it is "a clearer way of expressing the relevant

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and Bill are aware of, is salient in the context. We can capture this reading by making 'is inductive' and 'is finite' relative to the perspective of an audience member for whom these predicates have a different meaning.

[17]We could even talk of the *coherence* of a statement relative to a perspective, instead of the truth of a statement relative to a perspective, if this is less liable to confuse.

[18]A limitation of this strategy is that we would only distinguish the meaning of one contradiction from another contradiction in a context where a bizzare perspective index is available to be fed to whichever constituent of the contradiction is taken to be perspective sensitive. This contrasts with the intuition that one contradictory sentence might intuitively differ in meaning from another, even to a fully enlightened speaker. We think these cases can be dealt with in similar ways to (26b).

proposition and so is preferred over the version with two instances of the same name." We suspect that if a detailed pragmatic explanation of the contrast between (31) and (32) of this kind can be given, it would also apply to the contrast between (28) and (29).

No doubt this explanation needs developing; in any case, (28) is an example which merely shows the need to have a more detailed theory of when perspective shifting is possible. Apart from the difficult cases we have considered, P-HYPE applies straightforwardly to hyperintensionality outside attitude contexts. For this reason, we hypothesise that our semantic theory constitutes a possible account of unembedded mathematical/logical truths, albeit one which requires development and refinement in various respects.

4. Conclusion

P-HYPE provides a possible basis for a compositional hyperintensional phenomena, particularly involving propositional attitude verbs, but also for cases of unembedded mathematical/logical truths. It is able to capture certain aspects of Asudeh and Giorgolo (2016) which are not formalised in their account. Elsewhere, we will develop a more detailed theory of how to constrain and structure perspectives in P-HYPE, in addition to providing an informative comparison between P-HYPE and other hyperintensional semantic theories.

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The evolution of adjectival monotonicity[1]

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Abstract. A striking property of scalar adjectives is that they allow for inferences like the following: If John is tall, and Mary is taller than John, then Mary is tall. This inference can be made because if an individual falls in the extension of the adjective, then any individual that has the property to a greater degree also will. We call this universal of adjectival semantics *monotonicity*. In this paper, we present an evolutionary account of monotonicity and support it with three computational models. In the first model, we study which of the possible meanings of scalar adjectives evolve under a pressure for simplicity alone, and we observe degenerate meanings that are unlike natural language adjectives. In a second model, we combine the pressure for simplicity with a pressure for communicative accuracy. Under these pressures, mostly non-monotonic meanings evolve. In the third model, we equip the agents with pragmatic reasoning skills. In the third condition monotonic meanings prevail. We conclude that adjectival monotonicity is caused by a combined pressure for semantic simplicity and communicative accuracy, given human pragmatic skills.

Keywords: Iterated Learning, cultural evolution, universals, Rational Speech Act.

1. Introduction

Scalar adjectives like "tall", "fast" and "full" are used in predicative position to relate individuals to degrees of properties. The degree is specified precisely in *measure* uses, e.g. "Mary is 190cm tall", and imprecisely in *bare* uses, e.g. "Mary is smart". Bare uses convey that the degree to which the individual possesses the property falls in a certain portion of the scale, the *bare extension* of the adjective in the conversational context of the utterance. For instance, "Mary is tall" means that Mary's height is greater than a certain threshold, and "Mary is short" means that Mary's height is lower than a certain threshold. A striking property of scalar adjectives is that they allow for inferences like the following: If John is tall, and Mark is taller than John, then Mark is tall. These inferences can be made due to the property of *increasing (decreasing) monotonicity*: if an individual falls in the extension of the adjective, then any individual that has the property to a greater (lower) degree will also fall in the extension of the adjective. More formally, we call a bare extension P monotonically increasing (decreasing) iff for any two degrees d_i and d_j, if $d_i \geq d_j$ ($d_j \geq d_i$) and $d_j \in P$, then $d_i \in P$. P is monotonic iff it is monotonically increasing or decreasing. We call monotonic those adjectives whose bare extension is monotonic in every conversational context.[2]

In the semantic literature, although scalar adjectives have been modelled in several different

[1]We would like to thank Kenny Smith, Jennifer Culbertson, Robert Truswell, Shane Steinert-Threlkeld, Jakub Szymanik, and Isabelle Dautriche for helpful discussion.

[2]In some of the literature (see below), *all* adjectives are increasing monotonic. This is because negative adjectives refer to different scales from their positive counterparts. For instance, "short" is increasing monotonic because its bare extensions consists of every degree of shortness higher than a threshold. There are numerous arguments for this analysis (Kennedy, 2001; Bierwisch, 1989). In the following, we will talk as if adjectives of opposite polarity extended on the same scale, e.g., the scale of height for "tall" and "short". However, this is for ease of presentation and is easy to reformulate in a way that is consistent with the literature.

ways (Klein, 1980; Kennedy and McNally, 2005; Kennedy, 2007), the monotonicity assumption is considered uncontroversial. However, monotonicity is not semantically necessary. Prima facie, English could have included a scalar adjective "schtall" such that "Mary is schtall" means that Mary is either shorter than 150cm or taller than 190cm. This possibility raises the question of why monotonicity is a general property of scalar adjectives. The topic of generally occurring patterns in semantic structure (or semantic universals; von Fintel and Matthewson (2008)) has seen a recent increase in attention. Important questions about how we can functionally explain these patterns are being addressed, quite recently, in learning experiments as well as various types of computational model.

Properties to do with scalarity have been studied particularly in the domain of quantifiers. While not identical, quantificational and adjectival monotonicity are similar. Consider a quantifier Q of type $\langle\langle e,t\rangle, \langle\langle e,t\rangle, t\rangle\rangle$. Q is (right-)monotone iff for any sets A and B either $Q(A,B) \wedge B \subseteq B' \implies Q(A,B')$ or $Q(A,B) \wedge B' \subseteq B \implies Q(A,B')$ (we omit the model M for simplicity). If we order the sets by inclusion and call Q^A the set $\{B \mid Q(A)(B) = \text{True}\}$, Q is monotone iff for any sets A, B and B', either $B \in Q^A \wedge B \leq B' \implies B' \in Q^A$ or $B \in Q^A \wedge B' \leq B \implies B' \in Q^A$. In this formulation, quantificational monotonicity is strikingly similar to adjectival monotonicity.

Steinert-Threlkeld and Szymanik (forthcoming) focus on monotonicity from the point of view of learning, corresponding to the level of single agents in the model below. They pose the challenge to provide a model of learning on which monotonic quantifiers are easier to learn than non-monotonic ones. They propose *long short-term memory (LSTM) recurrent neural networks (NN)* as a model of learning, and show that LSTM NNs require fewer observations to learn monotonic quantifiers than non-monotonic quantifiers. Furthermore, they argue that LSTM NNs have the advantage of being domain-general and biologically plausible. In virtue of their generality, LSTM could provide a unified learning model for quantifiers, scalar adjectives and other scalar phenomena. This would in turns provide a cognitively plausible foundation for the computational model below.

Further experimental evidence for an advantage of monotonicity in learning comes from Chemla et al. (forthcoming). The authors conducted an experiment in which participants were presented with collections of objects and were taught a rule (resembling a quantifier) associated with specific collections . They show that participants were significantly faster at learning rules corresponding to monotonic quantifiers than those corresponding to non-monotonic quantifiers. This result supports the hypothesis that monotonicity in scalar concepts simplifies learning.

Brochhagen et al. (2016) develops an account similar to the one presented in this paper. It focuses on the large class of scalar expressions, encompassing quantifiers, scalar adjectives, and numerals. The aim is to explain the lack of upper bounds in the semantics of scalar expressions. The authors also propose a model that combines Rational Speech Act agents with pressures for communicative accuracy and simplicity. The approach we follow in this paper is related to that presented in Brochhagen et al. (2016), but there are crucial differences, which we will discuss in the discussion section below.

In this paper, we present a picture of the evolution of monotonicity as an adaptation to the competing pressures for learnability and communicative accuracy. Section 2.1 studies the effects of a pressure for learnability alone on the semantic structure of scalar adjectives. The languages that evolve are monotonic but they do not convey information about the world, and are therefore unlike natural language. In section 2.2, we add a pressure on the languages to be communicatively accurate. This causes a prevalence of non-monotonic languages. Finally, in section 2.3 we implement more sophisticated, pragmatically skilful agents. Monotonic languages evolve. Presenting three different models that explore how these pressures affect the resulting languages, we conclude that monotonicity is a consequence of the combined pressures for learnability and communicative accuracy in a population of pragmatically skilful agents.

2. A model for the evolution of monotonicity

2.1. Model 1: Pressure from learning

The need to be culturally transmitted creates a pressure on language to be learnable. Learnability itself depends, among other things, on the cognitive biases of the learner. The Iterated Learning (IL) modelling paradigm is a way to study how the cognitive biases of the learners shape the evolution of cultural phenomena (See Smith (2018) for a recent overview). In this section, we use an IL model and find that on its own it does not suffice to account for the emergence of monotonicity.

A standard IL model consists of a number of *chains*. Each chain consists of a number of generations $h_0, h_1, ..., h_n$. The life of agents in each generation $h_{i>0}$ has two stages. In the first stage, agents in h_{i-1} are selected to be *cultural parents* of the agents in h_i, and proceed to teach the language to their cultural children. In the second stage, the agents in h_i become the cultural parents of agents in h_{i+1}. In the case of h_0, the languages of the agents are picked at random from the set of all possible languages. We consider the frequency of each language type across all runs of the simulation for all generation after a burn-in period.

2.1.1. Language model

In our model, the world W has two components. First, an ordered set $O = \{D, \geq_D\}$ modelling a scale, where D is a set of three degrees. Second, a uniform probability distribution P_D over D modelling the probability of specific degrees being observed. The set M of meanings is the set of sets of degrees, i.e. $\mathscr{P}(D)$ (See figure 1). Each language l is a set $\{f_l, S, B_l\}$, where S is a set of three signals that is identical for all languages, B_l is a set of three possibly identical meanings $\in M$ and $f_l : S_l \mapsto B_l$ is a function from each signal to its corresponding meaning. In each language, each signal is associated with exactly one meaning, which means that there is no homonymy. However, two meanings in B_l can be identical, which means that synonymy is possible. We added the restriction that in every language there is at least one meaning to refer to each degree. The languages are holistic in the sense of Kirby et al. (2015) because signals have no internal structure. Each language therefore models a system of three adjectives in their bare use, e.g. “x is small”, “x is big”, “x is huge”, with a fixed conversational context.

2.1.2. Bayesian learning model

We model the learning process in a Bayesian framework. In the first model, each agent has an initial prior probability distribution over languages which models its expectation about the language to learn. As an agent observes more and more data produced by its cultural parent, the prior distribution gets updated and tends to give higher probability to the language that the cultural parent is speaking. A learning event in generation h_i unfolds as follows. An agent a_p is selected from h_{i-1} to be the cultural parent, and an agent a_c is selected from h_i to be the cultural child. Then, a_p observes degree d and sends a signal s_p to a_c describing d in a_p's own language. Agent a_c receives both s_p and d and updates its probability distribution over languages. For each language l, updating follows Bayes' rule:

$$p(l \mid d, s_p) \propto p(d, s_p \mid l) p(l) \propto p(d) p(s_p \mid d, l) p(l) \tag{1}$$

Since the probability of observing a degree is uniform across degrees, eq. 1 becomes:

$$p(l \mid d, s_p) \propto p(s_p \mid d, l) p(l) \tag{2}$$

After learning from the data, the child picks a language to use when teaching the following generation. Two kinds of agents can be defined based on how the pick their language given a posterior distribution. *Sampling* agents sample a language from the posterior distribution. *MAP* (maximum a posteriori) agents pick the language with the highest posterior (Kirby et al., 2014). We show the simulation results with both MAP and sampling agents.

2.1.3. Simplicity based prior, and likelihood

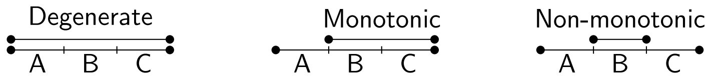
The prior distribution is based on work showing that learners prefer simpler, i.e., more compressible, languages (Culbertson and Kirby, 2016; Kirby et al., 2015). The prior probability for each language l is:

$$p(l) \propto 2^{-\gamma \mathscr{L}(l)} \tag{3}$$

Where γ models the strength of the bias for simpler languages and $\mathscr{L}(l)$ is the description length of language l. $\mathscr{L}(l)$ is the sum of the description lengths of the meanings expressed by the signals of l. We calculate the description length of each meaning as the number of bits needed to encode it.

We encode meanings as follows. Every meaning is a portion on the scale, namely that portion of the scale where the meaning applies (see figure 1). We call *transitions* the degrees where a meaning goes from applying to not applying or from not applying to applying. To encode a meaning, we first encode the position of all the meaning's transitions. Then, we specify whether the meaning applies at the start of the scale. This coding scheme allows to compress any meaning in $1 + c\log(n-1)$ bits, where c is the number of transitions in the meaning and $n-1$ is the number of possible transitions in the scale (fig. 1). Due to this coding scheme, monotonic meanings are attributed a higher prior probability than non-monotonic ones. If a meaning has no transitions, it can be compressed in one bit, which says whether the meaning contains all the degrees or is empty. We call such meanings *degenerate*.

Finally, the likelihood $p(s \mid d, l)$ is the probability of signal s being sent by a speaker of language l after observing a degree d. Calculating the likelihood requires a model of production, describing how agents pick a signal given a degree. There are two relevant cases to model. First, the probability of the agent producing a signal whose meaning does not contain the observed degree is 0. Second, if one or more available meanings are compatible with the observed



1 bit $<$ $1 + \log(2)$ bits $<$ $1 + 2\log(2)$ bits

Figure 1: “A”, “B”, and “C” are the scale’s three degrees. Each meaning is represented as a line extending over the degrees that belong to it. We estimate the complexity of a meaning as the length of a lossless encoding of the meaning.

degree, the agents need to choose which one to use for communication. For the simple agents in this model, the only semantic criterion for choosing between meanings is compatibility, so all compatible signals are equally likely to be chosen. This behaviour can be modelled as:

$$p(s \mid d, l) = \begin{cases} 0, & \text{if } d \notin f_l(s) \\ \dfrac{1}{|\{h \mid h \in B_l \wedge d \in h\}|} & \text{if } d \in f_l(s) \end{cases} \tag{4}$$

The production model in equation 4 has a number of desirable consequences. If a language only has one signal to refer to the observed degree, then the production probability is 1. A language that could not have produced a combination of signal and degree is judged impossible. Moreover, if two languages are equally probable a prior but one can only refer to refer to the observed degree with a single signal while the other has multiple signals, the former language is more probable.

The probability of each language is evaluated by the learner on a sequence of tuples $\langle \text{degree}, \text{signal} \rangle$. Given equation 4, the probability of a sequence $G = \langle \langle s_1, d_1 \rangle, ..., \langle s_n, d_n \rangle \rangle$ being produced by a speaker of language l is:

$$p(G \mid l) = \prod_{\langle s_i, d_i \rangle \in G} \frac{1}{|D|} p(s_i \mid d_i, l) \tag{5}$$

2.1.4. Results

We ran a pure IL condition for 3000 generations with a population of 10 agents for both MAP and sample agents. We discarded the first 500 generations as a burn-in. In figure 2 we plot the frequency of each language type across all agents and generations. The results show that in a simple IL condition both MAP and sample agents across all generations mostly learn degenerate languages. This result is predicted by the literature on IL. IL alone creates a pressure for languages to get increasingly learnable, i.e. conform to the prior expectations of the agents, and the prior favours simple languages.

However, degenerate languages are not what we observe in real world adjectival systems. Real world adjectives allow speakers to convey information about amounts of properties. The interim conclusion is therefore that a pressure for simplicity alone does not account for the evolution of non-degenerate monotonicity. The crucial advantage of non-degenerate meanings is their

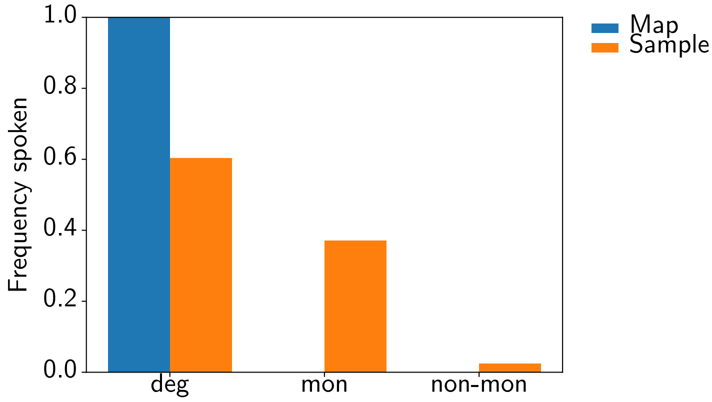


Figure 2: Frequency of monotonicity types under a learnability pressure alone averaged over 100 runs of the simulation.

greater expressiveness. We implement this idea in the next section by adding a pressure for communicative accuracy.

2.2. Model 2: Communicative pressure

2.2.1. Communication

In the present section, we add a selective pressure for accurate communication. After agents picked a language from their posterior distributions, communication in the population proceeds as follows. First, two agents a_S and a_H are picked to be the speaker and the hearer respectively. Agent a_S observes a degree $d_S \in D$ produced by the world and picks a meaning m_S with uniform probability among the ones in a_S's language that contain d_S . Then, a_S produces a signal s_S that expresses m_S in s_S's own language, as described in equation 4. Then, a_S sends the signal to a_H. Finally, a_H considers the meaning m_H expressed by s_S and picks a degree d_H with uniform probability among the degrees compatible with m_H in a_H's own language. The communication event is successful if $d_S = d_H$. Communication can be unsuccessful, either when speaker and hearer use different languages, or when more than one degree is compatible with the signal that was communicated. Given this picture of communication, the expected communicative success of an agent a_H with language l_H listening to an agent a_S with language l_S is:

$$c(a_H, a_S) = \sum_{\langle d_i, s_j \rangle \in D \times S} p(s_j \mid d_i, l_S) p(d_i \mid s_j, l_H) \tag{6}$$

where $p(s_j \mid d_i, l_d)$ is the probability described by equation 4 of a_S producing signal s_j and $p(d_i \mid s_j, l_H)$ is the probability of a_H guessing degree d_i.

The pressure for communicative accuracy is implemented by selecting agents to be cultural parents as a function of their communicative success:

$$p(a_j \text{ is selected}) \propto \exp(\varepsilon \cdot c(a_j, a_i)) \tag{7}$$

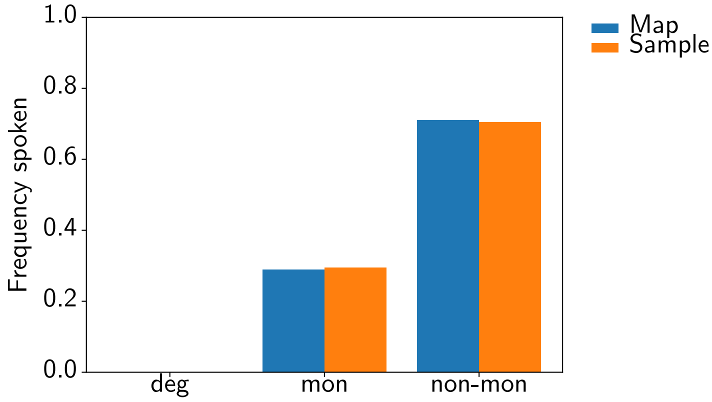


Figure 3: Frequency of monotonicity types with pressures for learnability and communicative accuracy averaged over 100 runs of the simulation.

where $\varepsilon > 0$ determines the strength of the selection and a_i is the cultural parent of a_j. The consequence of this way of calculating fitness is that languages that often provoke a failure in communication are taught less often to the following generation.

2.2.2. Results

We ran the model for 3000 generations with a population of 10 agents for both MAP and sample agents. Fig. 3 shows the frequency of each language type across all runs of the model, again with a burn-in period of 500 generations. Adding a pressure for communicative accuracy decreases the frequency of monotonic languages. Monotonic languages are communicatively less accurate than non-monotonic languages, and this affects the fitness of its agents negatively.

In section 2.1, degenerate monotonic meanings prevail in virtue of their simplicity. In the present section, non-monotonic languages prevail in virtue of their greater accuracy. However, both models fail as an evolutionary account of adjectival monotonicity. The communicative suboptimality of completely monotonic languages is tied with the way in which agents produce and understand signals. Agents in this model are literal, in the sense that they produce and understand signals as a function of their compatibility with observations alone. In section 2.3, we study the effects of implementing a more realistic model of communication that takes into account human pragmatic skills.

2.3. Model 3: Pragmatic agents

The literal agents in the models above base their linguistic behaviour purely on the semantics of their language, without exploiting the additional information that comes from interacting with cooperative rather than merely truthful agents (Grice, 1991). In the present section, we add a more sophisticated model of production and understanding, the so-called *Rational Speech Act* (RSA) model (Goodman and Frank, 2016).

2.3.1. Rational Speech Act agents

RSA is a way of modelling the way in which pragmatic communication follows from agents capable of thinking about each other's minds. An RSA pragmatic listener L_1 reasons about a pragmatic speaker S_1 which in turn reasons about a literal listener L_0. Literal listeners L_0 are agents of the sort we encountered in section 2.1.

Pragmatic speakers S_1 observe a degree d and calculate the utility that each signal s has for a literal listener L_0:

$$\mathscr{U}_{S_1}(s;d) = \log(p_{L_0}(d \mid s)) \tag{8}$$

were $P_{L_0}(d \mid s)$ is the probability that the literal listener attributes to degree d after having received signal s.[3] Signals that maximize the listener's posterior for the degree observed by the speaker have higher utility. Pragmatic speakers then choose the signal to utter with a probability proportional to the utility for the literal listener:

$$p_{S_1}(s \mid d) \propto \exp(\alpha \mathscr{U}_{S_1}(s;d)) \tag{9}$$

where α determines the strength of the increase in the probability of picking an utterance given an increase in utility.

Finally, pragmatic listeners L_1 perform Bayesian inference on the basis of the behaviour of S_1 agents. After receiving a signal s with meaning m from a speaker, L_1 calculates the probability of each degree:

$$p_{L_1}(d \mid s) \propto p_{S_1}(s \mid d) p_{L_1}(d) \tag{10}$$

where $p_{L_1}(d)$ is the prior probability that the listener attributes to the degree being observed.

2.3.2. Results

We ran 100 chains of 3000 generations each for both MAP and sample agents, with a population of 10 pragmatic agents per chain. We excluded the first 500 generations of each chain as a burn-in. Figure 4 shows the proportion of the languages spoken in the remaining generations by type.

The third model makes the correct prediction, namely that systems of adjectives evolve to be non-degenerate and monotonic. Implementing pragmatic skills, which gives artificial agents the ability to calculate scalar implicatures, allows agents to accommodate the prior preference for monotonic extensions without losing in terms of communicative accuracy. Monotonic, non-degenerate languages are the best trade-off between communicative and learnability pressure only if agents are pragmatically skilful.

3. Discussion

With our models, we have provided an evolutionary account for the monotonicity property of scalar adjectives: monotone adjectival meanings constitute the best solution for learnability and communicative accuracy, if we assume that language users are capable of pragmatic reasoning. As mentioned above, Brochhagen et al. (2016) develop an account that is similar to ours but

[3] We simplify the original model by assuming that the utterance cost is the same for all adjectives.

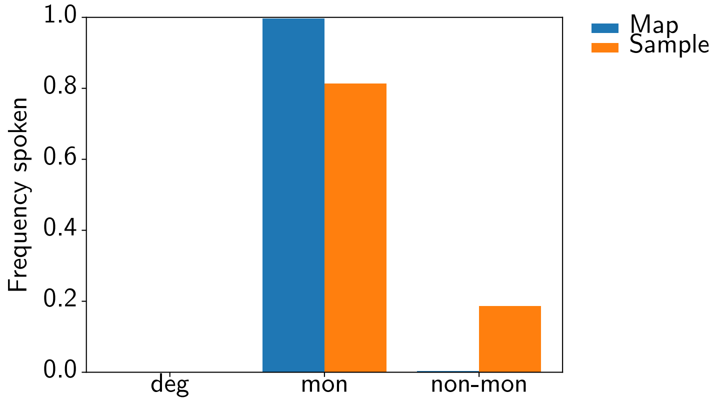


Figure 4: Frequency of monotonicity types with pragmatic agents averaged over 100 runs of the simulation.

differ in some crucial respects. The meanings are less structured than in the models above. The structure of each meaning is a function of its relation to an upper bound; each meaning can cover what is below the upper bound, what is above, both, or neither, and is therefore encoded with two bits. This modelling choice has two consequences. The first is that there are no degenerate meanings in the sense we have used above. A meaning that is true for both states in Brochhagen et al. (2016) is not degenerate, but rather simply one that lacks an upper bound, e.g. the meaning of English “some”. In the models above, we concluded that a simplicity pressure alone was insufficient because it resulted in degeneracy. On the other hand, Brochhagen et al. (2016) exclude a pressure for simplicity alone because it results in all the signals getting the same meaning, i.e. the monotonic meaning. The two models offer therefore different arguments for the insufficiency of a simplicity pressure alone: avoidance of degeneracy in our model and of synonymy in Brochhagen et al. (2016).

Additionally, since Brochhagen et al. (2016) focus on a very general sense of scalarity, there is no obvious way to add structure to the model in a way that encompasses all the relevant semantic structures. As a consequence, the higher complexity of non-monotonic meanings and the size of this difference are stipulated in the model. While this is an explicit modelling choice to avoid introducing assumptions, it makes it harder to extend the measure of complexity beyond two signals. Since the model in Brochhagen et al. (2016) only has two states, there is not much need for an explicit functional form for complexity. One can simply specify how much more complex the non-monotonic meaning is than the monotonic one, and a great variety of complexity measures could fit the two picked complexity values for some parameters specification. On the other hand, calculating the complexity level of three or more meanings requires a decision about their relative complexity, ideally as a function of the differences in their semantic structure. Using scales to model the meaning structure of scalar adjectives allowed us to model the relations between the different meaning structures and their complexity. In sum, having a simple semantic model makes the model in Brochhagen et al. (2016) suitable to discuss different cases of scalarity, but working with only two states and two signals implies that their model cannot detect differences between degeneracy and monotonicity. Conflating degeneracy and monotonicity is problematic, given that experimental work shows that under a pressure for learning only, people prefer degenerate systems (Kirby et al., 2015).

In a related and more recent paper, Brochhagen et al. (2018) narrow their focus to quantifiers, and provide an explicit measure of complexity based on the set-theoretic analysis of generalized quantification. In this paper, the semantic model has more complexity, and includes three states, i.e. a representation of meaning that is more similar to what we did. However, other differences from the model above are introduced. Crucially, in Brochhagen et al. (2018) degenerate meanings are excluded from the set of possible meanings. The spread of degenerate languages was our reason for introducing a pressure for communicative accuracy. Instead, Brochhagen et al. (2018) introduces the communicative pressure to explain how the population converges to a single shared language. A second difference between our and Brochhagen et al. (2018)'s paper is how communicative fitness is calculated. In Brochhagen et al. (2018) what matters is how well agents can speak with the other agents in the same population. Letting agents interact within their generation is useful when studying convergence to a single language. On the other hand, we calculate communicative accuracy between cultural parent and offspring, implementing communication in a more restricted manner (and allowing for more variability in the population). Spike et al. (2017) compare various implementations of communication pressure in a computational model, and their results suggest that the direction of communication (horizontal vs. vertical) does not make a huge difference for obtaining a conventional signaling system. I.e., the two models may produce very similar results. However, how and whether the differences work out in the case of scalar meanings is still an open question.

Finally, we would like to go back to the observation that scalar adjectives are monotonic. Even though this statement seems largely uncontroversial among semanticists, the claim is not unchallenged. A claim against monotonicity as a general property of scalars can be found in Verheyen and Égré (2018). The authors propose an analysis of the meaning of gradable adjectives based on prototypes. More specifically, gradable adjectives have prototypes not in isolation, but only once they are relativised to a specific comparison population. Given the prototypes, the scale is carved into categories by letting each point belong to the category of its closest prototype[4]. This process induces a so-called *Voronoi* tessellation on the space (Gardenfors, 2004). Two features of Voronoi tessellations are problematic when they are used to model adjectival semantics. Firstly, Voronoi tessellations produce extensions that are convex. For systems of two prototypes on a one-dimensional space, the convex categories will be monotone. On the other hand, a system with three prototypes or more necessarily produces at least one convex non-monotone category. Verheyen and Égré (2018) consider systems of two adjectives of opposite polarity, e.g., "cold"/"warm". However, systems of real adjectives also include more extreme adjectives such as "hot". An account of the semantics of scalar adjectives has to explain why further adjectives do not limit the other adjectives in the system, making them non-monotonic. Our model explains this under the assumption that scalar adjectives are encoded in terms of threshold. However, an account based on prototypes cannot account for this using that explanation.

The second problem with an analysis based on prototypes is that Voronoi tessellations cover the

[4]The model of Verheyen and Égré (2018) is more complex, since each category is associated with multiple prototypes. However, this aspect of their model is not relevant to the present discussion.

whole space. This prima facie contradicts the existence of what has traditionally been called the *zone of indifference* (Sapir, 1944), i.e., a part of the scale between adjectives of opposite polarity that is not covered by either. (See Franke, 2012 for a game-theoretical account). For instance, people of average height are neither tall nor short and therefore fall in the zone of indifference. A possible way to reconcile the prototype account with the existence of the zone of indifference is to claim that the latter corresponds to a vague threshold. The vagueness of the threshold should explain the intuition that the degrees in the zone of indifference do not clearly fall under either of the antonyms. This is what Verheyen and Égré (2018) propose. The discussion therefore hangs on whether one thinks that at least some degrees in the zone of indifference clearly do not belong to either antonym. More experimental data and clearer empirical predictions from the threshold account are required to establish which analysis conforms better to linguistic intuitions.

We defined a ubiquitous property of scalar adjectives we named monotonicity. We then developed an evolutionary account of monotonicity. The simulations we presented give a novel explanation for the universal of monotonicity in scalar language. The mechanism underlying the spreading of monotonicity rests on a combination three facts, namely that monotonic meanings are simpler than non-monotonic meanings, that of language is shaped by both IL and pressure for accurate communication, and that human beings are capable of pragmatic reasoning.

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Another look at superlative modifiers as modified superlatives[1]

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Abstract. This paper studies the morpho-semantic puzzle of superlative modifiers (SMs) where in many languages SMs typically involve a quantity adjective and a degree morpheme. This paper takes English *at least* as a case study and offers a decompositional analysis connecting its semantic properties with its morphological components. One central proposal is that SMs like *at least* can be structurally decomposed into three morphological pieces: a quantity adjective, a superlative and an existential operator. It is shown that the current analysis not only explains the role of the quantity adjective and degree morphology in the semantics of *at least*, but also captures two types of semantic parallels suggested in the literature on SMs: the parallel with disjunction and the parallel with epistemic indefinites.

Keywords: superlative modifier, superlative, focus, degree, alternative

1. Introduction

Superlative modifiers (SMs) such as English *at least* and *at most* have posed a longstanding and intriguing morpho-semantic puzzle: Why do SMs morphologically involve a quantity adjective and the superlative morpheme? What is the role of quantity adjective and superlative morpheme inside SMs? How are these morphological pieces connected with the semantics of SMs? (1) and (2) below illustrate the relevant facts in English, where the same morphological components *least* and *most* are involved in SMs and superlatives.

(1) Superlative modifiers (SMs)
 a. John bought at **least** $[\text{three}]_F$ apples.
 b. John bought at **most** $[\text{three}]_F$ apples.

(2) Quantity superlatives (QSs)
 a. John drank the **least** water.
 b. John climbed the **most** mountains.

This paper is dedicated to the morpho-semantic puzzle of SMs by taking English *at least* as a case study, and offers a decompositional analysis connecting the semantics of *at least* with its degree morphology. One central proposal is that SMs like *at least* can be structurally decomposed into three pieces: a quantity adjective, a superlative and an existential operator.

The rest of this paper proceeds as follows. Section 2 introduces some semantic properties of *at least* (that have been observed in previous studies). Section 3 discusses the semantics of superlatives and points out one crucial semantic difference between SMs and superlatives. Section 4 spells out the decompositional analysis and shows how the semantic properties discussed in section 2 follows from the current proposal. Section 5 concludes the paper.

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2. Basic facts

This section introduces three empirical properties of English *at least* (some of them have been observed in previous studies, see e.g., Krifka, 1999; Geurts and Nouwen, 2007; Nouwen, 2010; Coppock and Brochhagen, 2013; among others): **(a)** it is focus-sensitive; **(b)** it is compatible with various types of scales and respect the monotonicity constraint; **(c)** it makes the prejacent the lower bound among the set of focus alternatives. First of all, it has been observed that *at least* is focus-sensitive: the semantic contribution of *at least* depends on its focus associate and different positions of the associate lead to truth-conditional differences. (3) and (4) (borrowed from Coppock and Brochhagen, 2013: 12) illustrates the point.[2]

(3) We should at least invite [the postdoc]$_F$ to lunch.

(4) We should at least invite the postdoc to [lunch]$_F$.

(3) and (4) are truth-conditionally different: the former conveys that we should invite the postdoc to lunch or some other people (higher-ranked than the postdoc in the context, say, assistant professor for example) to lunch; in contrast, the latter conveys that we should invite the postdoc to lunch or to some other occasions (higher-ranked than lunch in the context, say, dinner for example). Moreover, as discussed in Coppock and Brochhagen (2013), (3) and (4) are related to different discourse questions: the former addresses the question "Who should we invite to lunch?", while the latter the question "What should we invite the postdoc to?".

Second, *at least* is compatible with various scales (see Mendia, 2016a, b), as shown below.

(5) **Numeral Scales** (a contextual ranking: $4 \succ 3 \succ 2$)
John **at least** wrote [three]$_F$ novels.

(6) **Plurality Scales** (a contextual ranking: adam⊕bill⊕chris ≻adam⊕bill ≻adam)
John **at least** hired [Adam and Bill]$_F$.

(7) **Lexical Scales** (a contextual ranking: gold medal≻silver medal≻bronze medal)
John **at least** got a [silver]$_F$ medal.

(8) **Pragmatic Scales** (a contextual ranking: cherries ≻apples ≻bananas)
John **at least** bought [apples]$_F$.

Note that the numerical scale and plurality scale are based on semantic strength (entailment relation). Therefore, writing four novels *entails* writing three novels, and hiring Adam and Bill *entails* hiring Adam and hiring Bill. In contrast, the lexical scale and pragmatic scale are based on pragmatic strength (non-entailment relation). Thus, winning a gold medal does *not* entail winning a silver medal, and buying apples does *not* entail buying bananas.

Moreover, a novel observation here is that the ranking of the alternatives seems to respect the monotonicity property (cf. Schwarzschild, 2006). By manipulating the context, it seems easy

[2] To my knowledge, Krifka (1999) is the first study pointing out that English *at least* is focus-sensitive.

enough to reverse the ordering between the alternatives in the case of pragmatic scales.[3] In contrast, however, it does not seem possible to reverse the ordering in the case of numerical scales or plurality scales, even with some contextual effort.

(9) Context: John and his friends plan to have a party. John is responsible for buying some fruit for the party. There are three types of fruit available to them: cherries, apples and bananas. However, they are poor and do not have enough money to buy everything. For them, bananas are the optimal because they are the cheapest; apples are less optimal but acceptable because they are still cheaper than cherries.
The contextual ranking (in terms of price): <u>bananas $\succ$apples $\succ$cherries</u>

(10) Context: John is planning to hire some people. There are three applicants in the discourse: Adam, Bill and Chris. But the budget is limited. If three people are all hired, John needs to pay a great amount of money for their salary. If only Adam and Bill are hired, the situation is better, but John still pays more than he does in hiring only Adam. The best situation is simply to hire just one person while getting all the work done.
The intended contextual ranking: <u>only adam $\succ$only adam&bill $\succ$only adam&bill&chris</u>

Under the context (9), the utterance with *at least* in (8) is understood to convey that John bought apples or bananas (given the contextual ranking: bananas $\succ$apples $\succ$cherries). This means that the original ranking (cherries $\succ$apples $\succ$bananas) in (8) is now **reversed**. In contrast, the utterance with *at least* in (6) cannot be understood to be that *Liubei* hired only Adam and Bill, or hired only Adam, even with the contextual massage in (10). This indicates that the original ranking (adam&bill&chris $\succ$adam&bill $\succ$adam) in (6) **cannot** be reversed. The same observation applies numeral scales. I leave it for readers to verify the case of numerical scales. In short, these facts indicate that there is an intrinsic discrepancy between scales based on semantic strength and those based on pragmatic strength.

Third, in each sentence (5) – (8), the associate of *at least* is made as the lower bound among the set of focus alternatives. Take (5) for example, the sentence is judged true if and only if John wrote three novels or John wrote more than three novels, where the number *three* (the focus associate) is the lower bound on the quantity of novels that John wrote. Similarly, in (7), a silver medal is the lower bound on the type of medals that John won.

To sum up, I have shown that *at least* demonstrates three semantic properties: **(a)** it is focus-sensitive; **(b)** it is compatible with various types of scales and respect the monotonicity constraint; **(c)** it makes the prejacent the lower bound among the set of focus alternatives. With these in mind, the task then is how to account for those semantic properties of *at least* while connecting with the contribution of its superlative morphology *least*. To be concrete, the empirical facts to be captured in this paper are summarized in (11).

(11) The morpho-semantic properties of English *at least*
 a. **The morpho-semantic puzzle**: The same morphological components *least* are involved in superlative modifiers (*at least*) and quantity superlatives (*the least*).
 b. **Focus-sensitivity**: The semantic contribution of *at least* depends on the position of its focus associate.

[3] For lexical scales, although context manipulations are not impossible, they are harder because the ordering is based on our common world knowledge. Instances of lexical scale are *gold medal $\succ$silver medal $\succ$bronze medal*, and *full professor $\succ$associate professor $\succ$assistant professor*.

c. **Scale types and their discrepancy**: *At least* is compatible with various scales (based on semantic strength or pragmatic strength). However, in contrast to lexical scales and pragmatic scales, the ordering between the alternatives cannot be reversed in numerical scales and plurality scales.
d. **The bounding property**: Under sentences with *at least*, the prejacent is set up as the lower bound among the set of focus alternatives.

Before spelling out the decompositional analysis of *at least*, I would like to briefly discuss the semantics of superlatives and point out one crucial semantic difference between superlative modifiers and superlatives: the former conveys **the non-strict comparison relation**, but the latter encodes **the strict comparison relation**.

3. The semantics of superlatives

A sentence containing a superlative expression, such as *the highest mountain* in (12), can receive different interpretations depending on how the comparison class is specified with respect to different constituents of the sentence (e.g., Heim, 1985, 1999; Hackl, 2009). When the comparison class is determined with respect to the superlative DP itself, the absolute reading arises. In contrast, the relative reading arises when the comparison class is established with respect to one of the constituents in the sentence, such as Adam.

(12) Adam climbed the highest mountain.
Absolute reading: Adam climbed the mountain that is higher than any other (relevant) mountain.
Relative reading: Adam climbed a mountain that is higher than any other (relevant) individual did.

Heim (1999) propose that the absolute-relative ambiguity of a superlative sentence is derived by allowing the superlative morpheme *–est*, with the semantics in (13), to take different scope within the clause. Under this movement approach, the ambiguity of a superlative sentence is actually a case of structural ambiguity. The computation of the relevant pieces is illustrated below, with the absolute reading in (14) and the relative reading in (15).

(13) a. $[\![\text{-}est]\!] = \lambda C_{<e,\,t>}\, \lambda G_{<d,\,et>}\, \lambda x_{<e>}.\forall y[y\in C \wedge y \neq x \rightarrow \max(\lambda d.G(x, d)) > \max(\lambda d.G(y, d))]$
b. Presuppositions: $x\in C$, $\forall y[y\in C \wedge y \neq x \rightarrow \exists d[G(y, d)]]$

(14) Absolute Reading
a. $[_{DP}$ the $[_{NP}$ [-***est*** (C)]$[_{NP}$ d-high mountain]]]
b. $[\![d\text{-high mountain}]\!] = \lambda d.\lambda x.\text{mountain}(x) \wedge \text{high}(x)\geq d$
c. $C = \{x: \exists d.\text{mountain}(x) \wedge \text{high}(x)\geq d\}$
d. $[\![\text{DP}]\!] = \iota x\forall y[y\in C \wedge y \neq x \rightarrow \max(\lambda d.\text{mountain}(x) \wedge \text{high}(x)\geq d) > \max(\lambda d.\ \text{mountain}(y) \wedge \text{high}(y)\geq d)]$

(15) Relative Reading
a. $[_{IP}$ Adam [-***est*** (C)] $\lambda d.\ \lambda x.$ $[_{vP}$ x climbed a d-high mountain]]
b. $C = \{x: \exists d\exists z[\text{mountain}(z) \wedge \text{high}(z)\geq d \wedge x \text{ climbed } z]\}$
c. $[\![\text{IP}]\!] = 1$ iff

$\forall y[y \in C \wedge y \neq \text{adam} \rightarrow \max(\lambda d.\exists z[\text{mountain}(z) \wedge \text{high}(z) \geq d \wedge \text{adam climbed } z])$
$> \max(\lambda d.\exists z[\text{mountain}(z) \wedge \text{high}(z) \geq d \wedge y \text{ climbed } z])$

Under the absolute reading in (14), the superlative morpheme takes scope within the DP and the comparison class C is a set of relevant mountains. In contrast, under the relative reading shown in (15), the superlative morpheme takes scope outside the DP (specifically, -*est* scopes over the VP) and the comparison C is a set of relevant mountain-climbers.

Alternatively, some researchers purse an in-situ approach (e.g., Farkas and Kiss, 2000; Sharvit and Stateva, 2002), where the superlative morpheme never moves out of the DP, and the relative reading is derived from domain restriction. Consider (16), where the bolded part indicates the additional contextual restriction on the value of C.

(16) Relative Reading (an in-situ approach)
a. $[_{DP}$ the $[_{NP}$ [-***est*** (C)]$[_{NP}$ d-high mountain]]]
b. $[\![d\text{-high mountain}]\!] = \lambda d.\lambda x.\text{mountain}(x) \wedge \text{high}(x) \geq d$
c. $C = \{x: \exists d \exists z.\text{mountain}(x) \wedge \text{high}(x) \geq d \wedge z \text{ climbed } x\}$
d. $[\![\text{DP}]\!] = \iota x \forall y[y \in C \wedge y \neq x \rightarrow \max(\lambda d.\text{mountain}(x) \wedge \text{high}(x) \geq d)$
$> \max(\lambda d.\ \text{mountain}(y) \wedge \text{high}(y) \geq d)]$

At this point, it is worth noting that superlatives are focus-sensitive (e.g., Heim, 1999). For example, (17) and (18) are truth-conditionally different; on the relative reading, (17) conveys that John bought more apples on Sunday than any other day, while (18) conveys that John bought more apples than anyone else did on Sunday.

(17) John bought the most apples on $[\text{Sunday}]_F$.

(18) $[\text{John}]_F$ bought the most apples on Sunday.

To synthesize the scope-taking property of the superlative morpheme and the contribution of focus, Heim (1999) provides another possible entry as defined in (19). The idea behind (19) is that focus helps set the contextual value of the domain C. Put differently; focus restricts the domain of the superlative operator.

(19) a. $[\![\text{-}est]\!] = \lambda C_{<<d,t>,t>} \lambda P_{<d,t>} \forall Q[Q \in C \wedge Q \neq P \rightarrow \max(\lambda d.P(d)) > \max(\lambda d.Q(d))]$
b. Presuppositions: $P \in C$, $\exists Q[Q \in C \wedge Q \neq P]$

With (19) in mind, the relevant computation of (17) is shown in (20), and the relevant computation of (18) is shown in (21).

(20) a. The LF of (17): [-***est*** (C)] [λd. $[_{IP}$ John bought d-apples on $\text{Sunday}_F]$~C]
b. $C = \{x: \lambda d.$ John bought d-apples on $x\}$
c. $[\![(17)]\!] = 1$ iff $\forall Q[Q \in C \wedge Q \neq (\lambda d.$ John bought d-apples on Sunday)
$\rightarrow \max(\lambda d.$ John bought d-apples in Sunday) $> \max(\lambda d.Q(d))]$

(21) a. The LF of (18):[-***est*** (C)] [λd. $[_{IP}$ John_F bought d-apples on Sunday]~C]
b. $C = \{x: \lambda d.\ x$ bought d-apples on Sunday$\}$
c. $[\![(18)]\!] = 1$ iff $\forall Q[Q \in C \wedge Q \neq (\lambda d.$ John bought d-apples on Sunday)

$\rightarrow \max(\lambda d.\ \text{John bought } d\text{-apples in Sunday}) > \max(\lambda d.Q(d))]$

In both cases; the superlative operator plus its domain restrictor ***-est*** (*C*) takes scope over the whole sentence. Recall that the crucial difference between (17) and (18) lies in the position of focus. Crucially, the effect of focus is captured by different contextual values of the domain *C*: in (20b), the set of degree properties vary with respect to the days John bought apples, while in (21b) the set of degree properties vary with respect to the individuals who bought apples on Sunday.[4]

The choice between a movement approach and an in-situ approach is an ongoing debate in the literature on superlatives. However, it may well be that both approaches are needed (see Tomaszewicz, 2015 for a comparative perspective on the correlation between definiteness marking and different types of relative readings).[5] The debate between the two approaches will not concern us in this paper. What is crucial here is that under either approach, the semantics of superlatives, like that of comparatives, encode a strict comparison relation: a greater-than relation symbolized by > (or a less-than relation symbolized by <).

In a sharp contrast to the strict comparison relation in the semantics of superlatives, a non-strict comparison relation (e.g., the greater-than/ less-than or equal-to relation) has been assigned to the semantics of *at least* in the previous studies, as shown in (22).[6]

(22) The non-strict comparison relation of *at least*

a. The degree-based approach (e.g., Kennedy 2015)

$[\![at\ least]\!] = \lambda m_{<d>} \lambda P_{<d,\ t>}.\ max\{n \mid P(n)\} \geq m$

b. The discourse-based approach (e.g., Coppock and Brochhagen 2013)

$[\![at\ least\ (C)]\!]^{w,\ g} = \lambda p_{<s,\ t>}.\exists q\ [q \in C \wedge q(w) \wedge q \succeq_{\mathbf{i}} p]$

Although the non-strict comparison relation may correctly characterize the truth-conditions of sentences with *at least* (see section 2), it raises a non-trivial question in connecting with the semantics of superlatives: Where does the "equal-to" relation (i.e., =) come from? From our discussion above, superlatives encode the strict-comparison, but not the non-strict one.

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[4] In explicating the role of focus, the three-place superlative operator requires the movement of the focus-marked constituent to serve as its third argument. Heim (1999) discusses this point and explicitly expresses her doubt that multiple LFs actually go with the *relative prominence* on focus-marked constituents at PFs. Readers are referred to Heim (1999) and Sharvit and Stateva (2002) for discussion on the role of focus in superlatives.

[5] A crucial assumption under the movement approach is that the definite article *the* in superlatives is optionally interpreted as an indefinite (Heim,1999). This assumption has been a soft spot for the movement approach. However, couched in the framework of dynamic semantics, Bumford (2017) recently argues that the definite article *the* can be semantically decomposed into two components: one builds a set of witness that satisfies the restricting noun phrase and the other imposes the uniqueness test. The former amounts to the meaning of an indefinite in dynamic semantics. Under the relative reading, the superlative morpheme *–est* takes a parasitic scope (in the sense of Barker, 2007) between the first and the second component of *the*. Bumford's analysis elegantly removes the long-standing soft spot for the movement approach. Readers are referred to his paper for details. See also Coppock and Beaver (2014) for discussion of definiteness marking in superlatives.

[6] Although there have been various proposals for the semantics of *at least*, they can be generally classified into two approaches, depending on what kind of scales SMs are thought to make reference to: a degree-based approach and a discourse-based approach. The degree-based approach considers SMs as degree operators and invokes a scale of degrees (Nouwen, 2010; Kennedy, 2015). In contrast, the discourse-based approach invokes scales of pragmatic strength, which are not restricted to numerals and may not even respect entailment (e.g., Krifka, 1999; Geurts and Nouwen, 2007; Büring, 2008; Coppock and Brochhagen, 2013).

Despite the issue of the strict comparison vs. non-strict comparison, both superlatives and superlative modifiers do convey a similar bounding property. (23) and (24) illustrate the point.

(23) a. John drank the least coffee. Superlative
b. John ate at least [three]$_F$ apples. Superlative modifier

(24) a. John ate the most apples. Superlative
b. John ate at most [three]$_F$ apples. Superlative modifier

In (23), sentence (a) conveys that the quantity of coffee that John drank is the *lowest*, and sentence (b) that the *lowest* quantity of apples that John ate is three. Similarly, in (24), sentence (a) conveys that the quantity of apples that John ate is the *greatest*, and sentence (b) that the *greatest* quantity of apples that John ate is three. This semantic parallel on the bounding property suggests that superlatives and superlative modifiers should be intrinsically connected in the semantics, beyond the level of surface morphology.

To sum up, we have seen that one crucial aspect in the interpretation of superlatives lies in how the content of the comparison class is determined; in this respect, focus plays an important role in shaping the comparison class. Furthermore, we have also seen that superlatives semantically encode the strict comparison, while superlative modifiers convey the non-strict comparison. Finally, both constructions similarly convey a bounding property on the relevant scale. Given our discussion so far, anyone who wants to connect the semantics of superlatives with that of superlative modifiers, she has to find a way maintaining the strict comparison of superlatives while deriving the non-strict comparison of superlative modifiers somewhere else. The next section provides one such proposal.

4. The proposal

The section proceeds as follows. Section 4.1 proposes that *at least* can be structurally decomposed into three major components: a quantity adjective (Q-adjective), a superlative SupP and an existential operator E-OP. Also, it demonstrates how the three components are semantically composed in the internal structure of *at least*. Section 4.2 first illustrates how the current decompositional analysis captures the semantic properties of *at least* (discussed in section 2) and then discusses how the two types of semantic parallels (the parallel with disjunction and that with epistemic indefinites) are captured.

Below, I briefly introduce two core assumptions in this paper. First, I assume Rooth (1992)'s focus semantics. Briefly put, every expression φ has an ordinary semantic value and a focus semantic value. For an unfocused constituent, its focus semantic value is a singleton set containing the ordinary value of that expression. For a focused constituent, its focus semantic value is a set of alternatives: a set of objects that have the same semantic type as the focused constituent. The set of alternatives induced by focus is computed recursively (essentially as in Rooth, 1992). Furthermore, the semantic contribution of a focus-sensitive operator depends on the focus semantic value of its sister. The set of focus alternatives projects until they meet the focus operator where they are interpreted by a squiggle operator ~ and restricted by a contextual variable C. The definition of ~ in (25) is drawn from Rooth (1996: (20)).

(25) Where φ is a syntactic phrase and C is a syntactically covert semantic variable, $\varphi \sim C$ introduces the presupposition that C is a subset of $[\![\varphi]\!]^f$ containing $[\![\varphi]\!]^o$ and at least one

another element.

Second, I assume Bobaljik (2012: 4)'s Containment Hypothesis, as shown in (26).

(26) Containment Hypothesis (Bobalijk, 2012: 4)
The representation of the superlative properly contains that of the comparative.

The next section presents a decomposition of English *at least*.

4.1. Decomposing *at least*

To begin with, I propose that English SMs can be structurally decomposed into three major components: a quantity adjective (Q-adjective), a superlative SupP and an existential operator E-OP. Assuming Bobaljik (2012)'s Containment Hypothesis, I propose that in English SMs, the superlative construction structurally embeds a comparative construction, as illustrated in (27). Note that CompP represents the embedded covert comparative construction.

(27) $[_{\text{SupP}}$ *-est* $[_{\text{CompP}}$ Comp^0 $[_{\text{AdjP}}$ *much*]]] SupP

Regarding the semantic details, let's start in a bottom-up fashion. For the quantity adjective *mu*, I propose that it encodes a measure function μ_c, which maps the elements induced by focus to their corresponding positions along a contextually given dimension, as defined in (28). Note that η is a meta-variable, intended to capture the fact that the semantic type of focused elements may vary.

(28) $[\![much]\!]^c = \lambda\alpha.\mu_c(\alpha)$ $<\eta, d>$

Moreover, I propose that in the case of SMs, the measure function μ_c respects the monotonicity constraint, but crucially not restricted to it (cf. Wellwood, 2014, 2015). This has two consequences immediately. First, English SMs such as *at least* (and their cross-linguistic counterparts) can apply to the alternatives whose domain is not structured (e.g., by the part-of relation), as in the case of lexical scale and pragmatic scale. Second, when the domain of the alternatives is structured, as in the case of numerical scale and plurality scale, the structure-preserving mapping guarantees that the output ranking between the alternatives cannot be altered. The definition of monotonicity is offered below.

(29) Monotonicity
A measure function μ: $D_{\preceq Part} \rightarrow D_{\preceq Deg}$ is **monotonic** iff
for all $\alpha, \beta \in D_{\preceq Part}$, if $\alpha \prec^{Part} \beta$, then $\mu(\alpha) \prec^{Deg} \mu(\beta)$.

Given the current analysis, the discrepancy between different scale types is now derived: When the input focus alternatives have their own internal structure (e.g., a partial ordering or a total ordering), through a structure-preserving mapping, the output ranking between the alternatives cannot be altered despite contextual effort (e.g., numerical scale and plurality scale). In contrast, when the set of focus alternatives is NOT structured by entailment relation or part-of relation, the output ranking between the alternatives is subject to contextual factors and thus is not constant across contexts (e.g., lexical scale and pragmatic scale).

Next, the comparative morpheme Comp$^+$ (cf. English -*er*), after taking the Q-adjective *much* as its first argument, returns a comparison relation between the alternatives as in (30). The semantics of the superlative morpheme -*est* offered in (31) is like the entry traditionally assigned to English –*est* (Heim, 1999), except for the additional comparison relation and its type-flexibility. The semantics of SupP is obtained in(31), when the pieces are put together.

(30) $[\![\text{Comp}^+\text{P}]\!]^c = \lambda\alpha\lambda\beta.\mu_c(\alpha) > \mu_c(\beta)$ $<\eta, <\eta, t>>$

(31) $[\![\text{-}est]\!]^c = \lambda COM_{<\eta, <\eta, t>>}\lambda C_{<\eta, t>}\, \lambda\alpha_{<\eta>}.\forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow COM(\alpha, \beta)]$

Following the decompositional analysis of English *little* and *less* along the line in Heim (2006a, b) and Büring (2007), I propose that the quantity adjective *little* contributes to two semantic components at LF: a negative feature NEG and a covert *much* (see also Solt, 2009, 2015). The covert comparative morpheme Comp$^+$ combined with the negative feature NEG is reanalyzed as a covert comparative morpheme Comp$^-$ (with the opposite comparison relation), as defined in (32). The connection between Comp$^+$ and Comp$^-$ is reminiscent of Heim's and Büring's analyses of English *less* as a reanalyzed result from the combination of a negation contributed by adjectives with negative polarity (glossed as LITTLE in their analyses) and the comparative morpheme –*er*.

(32) NEG-Comp$^+$ is reanalyzed as Comp$^-$ (Heim, 2006a,b; Büring, 2007)

The semantics of Comp$^-$ (cf. English *less*) takes the Q-adjective *much* as its first argument and returns a comparison relation between the alternatives along a contextually-valued scale, as defined in (33). Combining with the meaning pieces of *much* and –*est* above, the semantics of SupP (i.e., *least*) involved in *at least* is obtained, as shown in (34).

(33) $[\![\text{Comp}^-\text{P}]\!]^c = \lambda\alpha\lambda\beta.\mu_c(\alpha) < \mu_c(\beta)$ $<\eta, <\eta, t>>$

(34) $[\![[_{\text{SupP}}\ \text{-}est\ [_{\text{Comp-P}}\ \text{Comp}^-\ [_{\text{AdjP}}\ much]]]]\!]^c$
$= \lambda C_{<\eta, t>}\, \lambda\alpha_{<\eta>}.\forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \mu_c(\alpha) < \mu_c(\beta)]$ SupP

Finally, the existential operator (propositional version), the third component, is offered below.

(35) $[\![\text{E-OP}]\!]^{w, c} = \lambda SUP_{<<st, t>, <st, t>>}\lambda C_{<st, t>}\, \lambda\alpha_{<st>}.\exists\gamma[\gamma\in C \wedge \gamma_w \wedge SUP\,(C, \alpha)]$

Putting together the semantics of SupP and that of E-OP, the semantics of *at least* (propositional version) is obtained in (36). [7] The overall internal structure of *at least* is in (37).

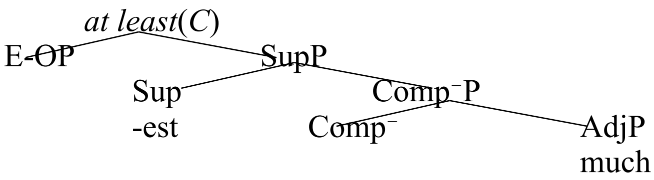
[7] To capture the fact that SMs can be syntactically adjoined to constituents of non-propositional meanings, one may assume that English *at least* also has the following non-propositional lexical entries, which are derived by type-shifting (e.g., the Geach rule and the backward Geach rule).

(i) a. A non-propositional version (by the Geach rule)
$[\![at\ least\ (C)]\!]^{w, c} = \lambda\alpha_{<\eta, st>}\lambda P_{<\eta>}.\exists\gamma[\gamma\in C \wedge \gamma_w(P) \wedge \forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \mu_c(\alpha(P)) < \mu_c(\beta(P))]]$

b. A non-propositional version (by the backward Geach rule)
$[\![at\ least(C)]\!]^{w, c} = \lambda\alpha_{<\eta>}\lambda P_{<\eta, st>}.\exists\gamma[\gamma\in C \wedge P_w(\gamma) \wedge \forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \mu_c(P(\alpha)) < \mu_c(P(\beta))]]$

(36) $[\![at\ least(C)]\!]^{w,c} = \lambda\alpha_{<st>}.\exists\gamma[\gamma\in C \wedge \gamma_w \wedge \forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \mu_c(\alpha) < \mu_c(\beta)]]$

(37) The internal structure of English SM *at least* at LF



According to (36), *at least* takes the prejacent proposition α and conveys that there is one proposition γ in the domain C such that γ is true. Moreover, the superlative SupP (i.e., $\forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \mu_c(\alpha) < \mu_c(\beta)]$) requires all the alternative propositions that are contextually relevant and non-identical to the prejacent α be higher ranked than the prejacent α. In other words, SupP excludes all the lower alternatives while keeping the higher alternatives. Given the focus presuppositions imposed by the squiggle operator ~ in (25), repeated as (38) below, the prejacent α has to be an element of the domain C. Taken together, an assertion with *at least* amounts to saying that there is one element γ in the domain C which is a set consisting of the prejacent α and its higher alternatives β such that the element γ is true. The apparent non-strict comparison in the truth-conditions of sentences with *at least* is thus derived, more specifically, from the interaction between the focus presuppositions imposed by the squiggle operator ~ and the semantics of the superlative SupP.

(38) $\alpha \sim C$ is defined iff $[\![\alpha]\!]^{o} \in C \wedge \exists\alpha'[\alpha'\neq\alpha \wedge [\![\alpha']\!]^{o} \in C] \wedge C \subseteq [\![\alpha]\!]^{f}$

Notice that E-OP is assumed to be covert in English and the preposition *at* is treated as semantically vacuous in the compositional process. One alternative view would be to say that the preposition *at* is actually an overt realization of the existential operator E-OP in English. On this view, it is important to note that English may not be the only language where the E-OP is overtly realized. Two other candidates are observed: the morpheme ***al*** in Italian SMs (*al massimo* 'at most' and *al meno* 'at least') and the morpheme ***au*** in French SMs (*au plus* 'at most' and *au moins* 'at least'). Seen in this light, I leave open this alternative view; further studies on the morpho-semantics of SMs are needed to verify whether the realization of the E-OP is limited to the family of Indo-European languages.

Before leaving this section, let me briefly highlight several important features of the current decompositional analysis of SMs: **(a)** Q-adjectives play a crucial role in encoding a measure function mapping the alternatives to their corresponding positions ordered along a contextually-valued scale; this provides the foundation of the scalarity of SMs; **(b)** the superlative SupP has dual roles: it not only serves as a domain restrictor of SMs but also crucially introduces the scalarity of SMs, which is a comparison relation between the prejacent and its alternatives; **(c)** the internal structure of *at least* contains a superlative, which in turn structurally embeds a comparative (Containment Hypothesis); **(d)** the existential operator E-OP might be overtly realized in some languages, while covert in others.

4.2. Deriving the semantic properties of *at least*

This section illustrates how the current analysis captures the semantic properties of *at least* (discussed in section 2). Recall that English *at least* demonstrates three semantic properties: **(a)** it is focus-sensitive; **(b)** it is compatible with various types of scales and there is a discrepancy between scales based on semantic strength (numerical scales and plurality scales) and those based on pragmatic strength (lexical scales and pragmatic scales); **(c)** it makes the prejacent the lower bound among the set of focus alternatives.

First, under the current analysis, information focus induces a set of elements serving as the input to the measure function in the semantics of Q-adjective. In this sense, focus determines the input domain of Q-adjective and it thus follows that *at least* is focus-sensitive.

Second, as mentioned in section 4.1, depending on whether the set of focus elements has its internal structure, a discrepancy between scales on semantic strength and those on pragmatic strength is expected. More specifically, when the set of the input focus elements stands in a partial ordering or a total ordering, through a structure-preserving mapping, the output ranking between the elements cannot be altered despite contextual effort. This is the case of numerical scales and plurality scales. In contrast, when the set of the input focus elements is NOT structured by the entailment relation or a part-of relation, the output ranking between the elements is subject to contextual factors and is thus not constant across contexts. This is the case of lexical scales and pragmatic scales. The discrepancy between scales is derived.

Third, under the current analysis, the bounding property of *at least* results from the fact that the prejacent is set up as the comparative standard in the strict comparison relation encoded in the semantics of the superlative SupP (see (34)). Below, the sentence (39) and its computation (40) illustrate the point.

(39) Adam is **at least** an $[\text{associate}]_F$ professor.

(40) a. LF: $[_{vP}$ **at least**(C) $[_{vP}$ $[_{vP}$ Adam be an $[\text{associate}]_F$ professor$]$ ~C$]]$[8]

b. $[\![at\ least(C)]\!]^{w,c}$
$= \lambda\alpha_{<st>}.\exists\gamma[\gamma\in C \wedge \gamma_w \wedge \forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \mu_c(\alpha) < \mu_c(\beta)]]$

c. $\alpha \sim C$ is defined iff $[\![\alpha]\!]^{o} \in C \wedge \exists\alpha'[\alpha'\neq\alpha \wedge [\![\alpha']\!]^{o} \in C] \wedge C \subseteq [\![\alpha]\!]^{f}$

d. $[\![(39)]\!]^{w,c} = 1$ iff
$\exists\gamma[\gamma\in C \wedge \gamma_w \wedge \forall\beta[\beta\in C \wedge \beta\neq\lambda w.$Adam is an associate professor in w
$\rightarrow\mu_c(\lambda w.$Adam is an associate professor in $w) < \mu_c(\beta)]]$

Because of the presuppositions introduced by the ~ squiggle operator (Rooth, 1992), the prejacent proposition α must be an element in the domain *C*. Furthermore, because of the domain restrictor SupP, all the elements *β* non-identical to the prejacent α are ranked above the prejacent α. Put differently, the semantics of SupP removes the lower alternatives from the domain *C*. Taken together; the domain *C* combined with the contribution of SupP now denotes a set consisting of the pejacent and its higher alternatives. According to (40), (39) is judged true if and only if there is one element in the domain (i.e., in the set consisting of the prejacent and its higher alternatives) such that the element is true. Assume that the set of propositional alternatives induced by focus is {*λw.Adam is a full professor in w*, *λw.Adam is an associate professor in w*, *λw.Adam is an assistant professor in w*}, given the ranking of the

[8] For simplicity and illustration, I assume that the preverbal *at least* is syntactically adjoined to vP and the subject *Adam* reconstructs back to Spec, vP (where it is originally generated). Nothing crucial in my proposal hinges on these assumptions.

alternatives is: *λw.Adam is a full professor in w* $\succ$ *λw.Adam is an associate professor in w* $\succ$ *λw.Adam is an assistant professor in w*, the truth-conditions in (40) require (39) to be true if and only if Adam is a full professor or Adam is an associate professor.

Note that a natural consequence of the current analysis is that both superlative modifiers and superlatives convey a similar bounding property, as we have seen in (23), because both constructions involve a superlative. Crucially, the apparent non-strict comparison of *at least* results from the focus presuppositions (i.e., the prejacent must be an element in the domain) and the semantics of SupP (i.e., it removes the lower alternatives while keeping the higher alternatives in the case of *at least*).

Before leaving this section, I would like to point out that the current analysis additionally captures two types of semantic parallels: **(a)** the parallel to disjunction (Büring, 2008); **(b)** the parallel to epistemic indefinites (Nouwen, 2015). Let's first consider the semantic parallel between *at least* and disjunction. Simply put, an existential claim over a set amounts to a disjunction of each element in the set. This is informally schematized in (41).

(41) The parallel with disjunction
$\exists\gamma\,[\,\gamma\in\{\alpha, \beta\} \wedge \gamma$ is true$]$ $\Leftrightarrow$ α is true $\vee$ β is true

Suppose that α, β and γ are propositions; α is the prejacent and β is the higher alternative. The claim that there is a proposition γ in the set $\{\alpha, \beta\}$ such that γ is true is equivalent to the disjunctive claim that the prejacent α is true or the proposition β is true. In this respect, under the current analysis, English *at least* is not only parallel with disjunction for the pragmatic calculation of ignorance inferences (as argued in Büring, 2008 and others), but also parallel with disjunction from the viewpoint of their semantics.

Finally, let's consider the parallel between *at least* and epistemic indefinites (EIs). Both SMs such as *at least* and EIs such as Spanish *algún* lead to ignorance inferences (e.g., Büring, 2008 on SMs and Alonso-Ovalle and Menéndez-Benito, 2010 on Spanish *algún*). For example, (42) illustrates the relevant Spanish example and (43) shows the semantics of *algún* proposed in Alonso-Ovalle and Menéndez-Benito (2010).

(42) Epistemic Indefinites: Spanish *algún*

María	se	caso´	con	**algún**	estudiante	del	departamento	de lingüística.
María	SE	married	with	ALGÚN	student	of the	department.	of linguistics

'María married a linguistics student.'

(43) $[\![algún]\!] = \lambda f_{<<e,t>, <e, t>>}$: anti-singleton ($f$). $\lambda P_{<e, t>}.\lambda Q_{<e, t>}.\exists x_{<e>}[f(P)(r) \wedge Q(r)]$

According to Alonso-Ovalle and Menéndez-Benito, by using *algún* in (42), the speaker is ignorant about the linguistics student who Maria married. As shown in (43), an important aspect in their analysis of *algún* is that it imposes an anti-singleton presupposition on the domain. In this respect, under the current analysis, the domain of *at least* will always be non-singleton, consisting of the prejacent (obtained by focus presuppositions) and the higher alternatives (obtained by the superlative SupP). In other words, *at least* and *algún* both require a non-singleton domain. This seems to be one common core of those expressions leading to ignorance inferences. For comparison, the semantics of *at least* is repeated below.

(44) $[\![at\ least(C)]\!]^{w,c} = \lambda\alpha_{<st>}.\exists\gamma[\gamma\in C \wedge \gamma_w \wedge \forall\beta[\beta\in C \wedge \beta \neq \alpha \rightarrow \mu_c(\alpha) < \mu_c(\beta)]]$

Note that the ignorance inference induced by *algún* seems obligatory (Alonso-Ovalle p.c.); in contrast, the ignorance inference associated with *at least* seems defeasible (e.g., Mendia, 2016b; among others), thus not obligatory.[9] Seen in this light, there is crucial semantic difference between *algún* and *at least* on the non-singleton requirement: In a contrast to *algún* where the anti-singleton requirement is a presupposition, the non-singleton domain of *at least* is part of the truth-conditions. This semantics of *at least* together with the pragmatics of focus result in the sensitivity of their ignorance inferences to different discourse questions (i.e., Questions-Under-Discussions in the sense of Roberts, 1996/ 2012).

5. A comparison with Coppock (2016)

This section presents a brief comparison between my decompositional analysis of SMs with Coppock (2016). Building on Penka (2010)'s and Solt (2011)'s insights on the compositional derivation of SMs, Coppock (2016) presents a decompositional analysis of English *at least* couched in Coppock and Brochhagen (2013)'s discourse-based analysis. There are three core ingredients in Coppock (2016). First, she assumes some sort of alternative semantics where natural language expressions are translated into expressions of a formal logic that denote a set of intensions. (45) shows how the adjective *tall* is translated under her semantic framework.

(45) $[\![tall]\!]^{w} = \{\lambda w\lambda d\lambda x.\ tall_w(d)(x)\}$

Next, she assumes the Containment Hypothesis, where a superlative structurally embeds a comparative. She assigns the comparative morphemes *–er* and *less* under phrasal comparatives the semantics in (46). Specifically, *-er* denotes a singleton set containing a function that expects, besides the world argument, a gradable predicate *G*, a comparative standard *s*, and a comparative target *t*, and returns true if the comparative target is *G* to a greater extent than the comparative standard. The entry of *less* encodes the opposite comparison relation.

(46) a. $[\![\text{-}er]\!]^{w} = \{\lambda w.\ \lambda G_{<d,\,\tau t>}\lambda s_{<\tau>}\lambda t_{<\tau>}.\ \max(\lambda d.G_w(d)(t)) > \max(\lambda d.G_w(d)(s))\}$
b. $[\![less]\!]^{w} = \{\lambda w.\ \lambda G_{<d,\,\tau t>}\lambda s_{<\tau>}\lambda t_{<\tau>}.\ \max(\lambda d.G_w(d)(t)) < \max(\lambda d.G_w(d)(s))\}$

Second, for the superlative morpheme *-t*, she assumes the following entry.

(47) $[\![\text{-}t]\!]^{w} = \{\lambda w.\ \lambda R_{<\tau,\,\tau t>}\lambda C_{<\tau>}\lambda x_{<\tau>}.\forall x'_{\tau} \in C.\ x \neq x' \rightarrow R_w(x, x')\}$

In order to compose meanings, she assumes a point-wise, intension-friendly version of functional application, as illustrated below. With the compositional rule, the meaning of *least* is offered in (49), where **m** is a contextually-specified gradable predicate.

(48) **Functional Application**
Let α and β be the only sub-trees of the tree γ. If

[9] For purposes of this paper, I do not discuss how the ignorance inference associated with *at least* arises. Given the proposed semantics of *at least*, the current analysis is compatible with the pragmatic approach where the ignorance inference of *at least* arises pragmatically from certain mechanism of implicature calculation (see e.g., Cummins and Katsos, 2010; Kennedy, 2015; Mendia, 2016a, b and Schwarz, 2016a, b for proposals and discussion).

(a) $[\![\alpha]\!]^w = \alpha'$, where α' is of type $<s, <\sigma , \tau>>$
(b) $[\![\beta]\!]^w = \beta'$, where β' is of type $<s, \sigma>$
Then: $[\![\gamma]\!]^w = \{\lambda w.f(w)(a(w)) \mid f \in \alpha' \wedge a \in \beta'\}$

(49) $[\![least]\!]^w = \{\lambda w.\ \lambda C_{<\tau>}\ \lambda x_{<\tau>}.\forall x' \in C \wedge x' \neq x \rightarrow \max(\mathbf{m}_w(x)) < \max(\mathbf{m}_w(x'))\}$

Finally, the most important ingredient from Coppock's analysis (I believe) is that the famous *at*-operator is actually meaningful: it introduces the alternatives and scales. The entry of *at* is provided in (50), with a sketchy compositional derivation in (51).

(50) $[\![at]\!]^w = \{\lambda w.\lambda S_{<\tau,<\tau,t>}\ \lambda x_{<\tau>}\ \lambda y_{<\tau>} \mid y \in C \wedge S_w(C)(x)\}$
'the set of things *y* in a comparison class *C* such that *x* is *S* [least/ most] in *C*'

(51) The case of *at least three*
a. The LF: [**at** [-**t** [**less** [**m**]]]] three]
b. $[\![at\ least]\!]^w = \{\lambda w.\lambda x_{<\tau>}\ \lambda y_{<\tau>} \mid y \in C \wedge \forall x' \in C \wedge x' \neq x \rightarrow \max(\mathbf{m}_w(x)) < \max(\mathbf{m}_w(x'))\}$
c. $[\![at\ least\ three]\!]^w = \{\lambda w.\ \lambda y_{<\tau>} \mid y \in C \wedge \forall x' \in C \wedge x' \neq 3 \rightarrow \max(\mathbf{m}_w(3)) < \max(\mathbf{m}_w(x'))\}$

At this point, it is worth noting that under Coppock's implementation, the job of *at*-operator not only introduces the alternatives and scales, but also *encodes* a non-strict comparison relation (see the meaning of *at* above). Specifically, the meaning derived for *at least three* under Coppock's analysis is a set consisting of the prejacent (the comparative standard) and the relevant higher-ranked elements: {3, 4, 5,…}, ignoring intensionality.

Although Coppock's analysis elegantly explains the morpho-semantic puzzle of SMs, several important questions are raised by her treatment of *at*: **(a)** Why doesn't focus introduce the alternatives in the first place, as in Rooth (1985, 1992)? **(b)** What is role of focus in the analysis after all? How to incorporate the contribution of focus in the analysis? **(c)** Why do SMs have a morpheme specialized in introducing alternatives and scales? **(d)** Shall we expect such alternative-introducing or scale-introducing morpheme to occur somewhere else in natural language? Maybe also in other focus particles like *only* and *even*?

Given these considerations, the decompositional analysis proposed in this paper differs from Coppock (2016) in several crucial respects. First, unlike Coppock's analysis, the current decompositional analysis is deeply connected with Rooth (1985, 1992)'s focus semantics. Second, assuming focus is anaphoric to some QUDs in a discourse (Rooth, 1992; Roberts, 1996/ 2012; among others), just like the discourse function of other focus particles (e.g., *only*), SMs imposes further restrictions on the set of (possible) answers, despite their internal complexity and an "anti-specific" domain. Third, as discussed in section 3, many discourse-based analyses assign a non-strict comparison relation to the semantics of SMs. An example lexical entry of *at least* following that approach is presented below.

(52) $[\![\textbf{\textit{at least (C)}}]\!]^g = \lambda p_{<s,t>}.\lambda w_{<s>}.\exists q\ [q \in C \wedge q(w) \wedge q \succeq_i p]$
Some alternative q in C and as strong as the prejacent p is true in w

However, an entry like (52) raises a non-trivial question pertaining to the morpho-semantic puzzle of SMs: While *at least* involves an **existential** quantifier and a **non-strict comparison**; superlatives typically involve a **universal** quantifier and a **strict comparison**, as in (53).

(53) a. Adam drank the **least** coffee.
b. $[\![(53a)]\!] = 1$ iff $\forall y[y \neq \text{Adam} \wedge y \in C \rightarrow \max(\lambda d.\ \text{Adam ate } d\text{-many coffee}) < \max(\lambda d.\ y \text{ ate } d\text{-many coffee})]$

In Coppock (2016)'s analysis, the non-strict comparison is obtained through the defined semantics of the *at*-operator. In contrast, under the current analysis, the non-strict comparison of SMs is only an illusion: it is derived from the SupP collaborating with focus presuppositions. There is no need to hard-wire a non-strict comparison relation into the semantics of SMs.

Finally, it is worth pointing out that that despite the several differences discussed above, the current analysis, in fact, is largely inspired by Coppock (2016). In particular, the two analyses share two significant assumptions: **(a)** both analyses adopt Bobaljik's Containment Hypothesis in their decomposition of SMs; **(b)** both analyses adopt the view that the internal structure of SMs is an instantiation of phrasal comparatives.

6. Concluding remarks

In this paper, I have proposed a decompositional analysis of SMs connecting their degree morphology with their semantic properties, by taking English *at least* as a case study. One central proposal is that SMs like *at least* can be structurally decomposed into three pieces: a quantity adjective, a superlative and an existential operator. There are several important features of the current decompositional analysis of SMs: **(a)** Q-adjectives play a crucial role in encoding a measure function mapping the alternatives to their corresponding positions ordered along a contextually-valued scale; this provides the foundation of the scalarity of SMs; **(b)** the superlative SupP has dual roles: it not only serves as a domain restrictor of SMs but also crucially introduces the scalarity of SMs, which is a comparison relation between the prejacent and its alternatives; **(c)** the internal structure of *at least* contains a superlative, which in turn structurally embeds a comparative (Containment Hypothesis); **(d)** both superlatives and SMs convey a similar bounding property because both involve a superlative. **(e)** the apparent non-strict comparison of *at least* is derived from the focus presuppositions combined with the semantics of the superlative SupP. **(f)** the existential operator E-OP might be overtly realized in some languages, while covert in others.

One important issue not touched in this paper concerns how the current analysis connects with an insightful distinction between comparative quantifiers (CQs) and SMs suggested by Nouwen (2010). To the best of my knowledge, Nouwen (2010) is the first study suggesting an insightful distinction between CQs and SMs. In his terminology, the former belongs to the group of Class A modifiers and the latter the group of Class B modifiers, as shown in (54). Nouwen (2010) further proposes that Class A modifiers are degree quantifiers while Class B modifies are not; the latter introduce a bounding property. Although the two classes are internally heterogeneous, Kennedy (2015: (4)) suggests that the distinction between the two groups of modifiers can be understood as in (55):

(54) a. Class A modifiers: *more/ fewer/ less than n*, *over n*, *between n and m*, etc…

b. Class B modifiers: *at least*, *at most*, *up to*, *maximally*, *minimally*, etc…

(55) a. Class A modifiers express **exclusive (strict) orderings** relative to the modified numeral.
b. Class B modifiers express **inclusive (non-strict) orderings** relative to the modified numeral.

Seen in this light, the underlying distinction between CQs and SMs can be understood as pointing to what kind of ordering relation is employed in the semantics. Crucially, the current analysis is not only compatible with the suggested distinction but also decompose the non-strict ordering relation further. More specifically, in the case of SMs, the non-strict ordering is not a semantic primitive, but derived from focus presuppositions together with the semantic contribution of a superlative component. However, it remains to be seen exactly how the different ordering relation (strict vs. non-strict) is connected with the contrast between CQs and SMs in the robustness of ignorance inferences. One possible line of thought would be that the inclusion of the prejacent (due to focus presuppositions) makes the domain of SMs always non-singleton and thus their resulting ignorance inferences would be more robust than those given by CQs, where their domain may not be always non-singleton (cf. Schwarzschild, 2002's idea on singleton indefinites). Overall, the current analysis of *at least* adds to Schwarz et al. (2012)'s insight that Class B modifiers are not homogeneous, particularly with respect to whether the inclusive (non-strict) ordering is a semantic primitive.

Finally, it is important to note that the current analysis cannot be the whole story for the morpho-semantic puzzle of SMs because more than one possible morpho-semantic mapping is attested in natural languages. More studies are needed to see how the morpho-semantic mapping works in (56) and (57).

(56) Quantity adjectives plus even-if (e.g., Japanese and Korean)

a.	*ooku-temo*	'at most'	Japanese
	many-even.if		
b.	*sukunaku-temo*	'at least'	
	few-even.if		

(57) Quantity adjectives plus comparatives (e.g., Magahi, Hindi, Russian)

a.	*jaadaa*	*se*	*aadaa*	'at most'	Magahi
	more	than	more		
b.	*kam*	*se*	*kam*	'at least'	
	less	than	less		

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Framing effects as a semantic puzzle: Putting the alignment-assumption account to a test

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Abstract. Framing effects are effects of linguistic variation (e.g. stating the amount of lives saved vs. lives lost) on judgments and decisions. This paper deals with a semantic-pragmatic account of framing effects as offered by Geurts' (2013) alignment-assumption account. The account radically differs from extant accounts by explaining framing effects in terms of counterfactual alternatives and alignment of scales. I report two experiments that tested predictions derived from the alignment-assumption account and that related to the effect of upward- vs. downward entailing comparative quantifiers. The results provide preliminary experimental support for the alignment-assumption account and pose challenges for other accounts of framing effects.

Keywords: framing effects, comparative quantifiers, evaluative predicates, entailment, scales.

1. Introduction

The term *framing effect* refers to the well-established finding that choices and judgments are systematically affected by varying the description of options and states of affairs. In the first demonstration of a framing effect (Tversky and Kahneman, 1981), participants were presented with the scenario of an imminent outbreak of a deadly disease expected to kill 600 people (see (1)). They were asked to choose between two alternative programs to combat the disease, with one program having a sure outcome (e.g. Program A1) and the other one a risky outcome (e.g. Program A2). The outcomes were presented either in terms of number of lives saved, as in (1), or in terms of number of lives lost, as in (2).

(1) Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

If Program A1 is adopted, 200 people will be saved.

If Program A2 is adopted, there is 1/3 probability that 600 people will be saved, and 2/3 probability that no people will be saved.

Which of the two programs would you favour?

(2) If Program B1 is adopted, 400 people will die.

If Program B2 is adopted, there is 1/3 probability that nobody will die, and 2/3 probability that 600 people will die.

The different framing of the options had a strong effect on participants' choices. In the *survive*-frame condition, the majority (72%) of the participants chose the program with the sure outcome, whereas in the *die*-frame condition, it was chosen only by the minority (22%) of the participants.

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Framing effects[1] are a robust finding; they have been demonstrated in numerous experimental studies (albeit the effects tend to be smaller than in the study by Tversky and Kahneman). Their source, however, is a matter of controversy. Accounts of framing effects range from questioning the truth-conditional equivalence of differently framed descriptions to attributing them to irrationality. In between are accounts that explain framing effects in terms of implicitly conveyed information. Considering the very basis of framing effects, they seem to cry out for a semantic-pragmatic account. Yet, framing effects have received only limited attention in the linguistic literature. A notable exception is the alignment-assumption account of Geurts (2009; 2013), which opens up a new perspective on framing effects by explaining them in matters of counterfactual alternatives and alignment of scales.

In what follows, I first give an overview of accounts of framing effects. Section 3 gives a description of the alignment-assumption account (Geurts, 2009; 2013). In Section 4, two experiments are reported that were designed to test predictions derived from the alignment-assumption account. The findings of the experiments are discussed within the framework of the alignment-assumption account as well as with regard to their implications for other accounts of framing effects. Section 5 concludes the paper.

2. Accounts of framing effects

Accounts of framing effects can be divided in three groups. They differ in their underlying assumptions about the equivalence of two differently framed descriptions. First, there are accounts that do not question the equivalence of the two description variants and explain framing effects in terms of representational differences. According to the second group of accounts, framing effects emerge because the descriptions in the two frames are not necessarily truth-conditionally equivalent. Third, there are accounts in which it is assumed that the two description variants are not information equivalent and in which the framing effect is attributed to a difference in implicit information between the two frames.

2.1. Accounts of group 1: representational difference between the two frames

Tversky and Kahneman (1981) interpreted their finding of a framing effect in terms of prospect theory, i.e., as an effect of framing on risk propensity. Prospect theory was developed by Kahneman and Tversky (1979) as a descriptive account of decision behavior under risk. In a nutshell, the central proposal of prospect theory is that choices involving gains tend to trigger risk aversion whereas choices involving losses tend to trigger risk seeking. In particular, it is presumed that the outcomes of choice options are perceived as gains or losses relative to

[1] In the literature, different types of framing effects are distinguished (Levin, Schneider and Gaeth, 1998). The framing effect in the study by Tversky and Kahneman is an example of *risky-choice framing*. A further main type of framing is *attribute framing*. In attribute framing tasks, participants do not have to choose between options, but rather are presented with an object to which a particular attribute is ascribed, either with a positive or a negative frame (e.g. The yoghurt is 90% fat free / contains 10% fat). Their task is to evaluate the object or, for example, to indicate whether they would buy it. Both types of framing effects are empirically well-established. In what follows, I will focus on risky-choice framing. However, the accounts of framing-effects that are described below can be applied to both types of framing.

a reference outcome, which is assigned a value of zero. Alternative descriptions of choice options may induce different reference outcomes[2]. Regarding the deadly-disease decision problem, it is assumed that the *survive*-frame induces a reference outcome of zero lives saved, such that the outcome of the sure option (200 lives saved) is perceived as a gain. In contrast, the *die*-frame induces a reference outcome of zero lives lost, such that the outcome of the sure option (400 lives lost) is perceived as a loss. In prospect theory, it is further proposed that the value function for gains differs from the value function for losses. The convex function for losses is steeper than the concave function for gains, such that losses "loom larger" than gains. Uncertain outcomes are assumed to be multiplied by a weight reflecting a nonlinear perception of probabilities, such that high and mid-level probabilities are underweighted more strongly than low probabilities are overweighted. Applied to the intervention programs in the deadly-disease scenario, the risk aversion in the *survive*-frame (see (1)) is due to the value of the gain of 200 lives saved being larger than the weighted value associated with a 1/3 probability of 600 lives saved. On the other hand, the risk seeking in the *die*-frame (see (2)) is due to that the negative value associated with 400 lives lost is smaller than the value associated with a 2/3 probability of 600 lives lost.

According to fuzzy-trace theory (Reyna and Brainerd, 1991; see Setton et al., 2014 for an overview), risky choice framing effects are not driven by fine-grained (subjective) representations of the stated quantities. Rather, people base their choices on coarse "gist" representations of the options' qualitative meaning (as long the gist representations are sufficient to discriminate between options)[3]. This key assumption of fuzzy-trace theory was inspired (cf. Reyna 2012) by the psycholinguistic distinction between verbatim memory and gist memory. A gist representation of the positively framed descriptions of the two options in the deadly-disease scenario (see (1)) is given in (3).

(3) If Program A1 is adopted, some people will be saved.
If Program A2 is adopted, some will be saved or no one will be saved.

In the gist representation in (3), quantities are reduced to dichotomies, i.e., 'some' vs. 'no one', and the probabilities in the risky option are reduced to a disjunction. As a consequence, both options include the outcome of saving some people and the decision between the two programs boils down to a decision between saving some people (Program A1) and saving no one (Program A2), rendering Program A1 as the better option (given that it is better that more people are saved than that less people are saved). (4) illustrates the gist representations of the negatively framed options (see (2)).

(4) If Program B1 is adopted, some people will die.
If Program B2 is adopted, no one will die or some people will die.

[2] The assumptions with regard to the assignment of reference outcomes seem to be largely intuition-based. That is, it is not clearly spelled out which factors determine the reference outcome (Werner and Zank, 2018).

[3] Fuzzy-trace theory assumes that in addition to gist representations, people encode verbatim representations to which they resort when the gist representations of two options do not differ – rendering the account difficult to falsify.

In (4), the decision is reduced to a decision between some people dying (Program B1) and no one dying (Program B2), rendering Program B2, i.e., the risky option, as the better option. In comparison to prospect theory, fuzzy-trace theory offers a more parsimonious account of framing effects. Moreover, findings of studies within the field of fuzzy-trace theory indicate that the representation of numerical information may not be the driving factor behind framing effects. For example, a strong framing effect still emerged when the options were described as in (3) and (4), i.e., when all numerical information was omitted (Reyna and Brainerd, 1991). This finding cannot be readily explained within the framework of prospect theory. Note, however, that the assumed gist representations of the options are somewhat ad hoc. For instance, it is unclear for which independent reasons, the gist representations for *1/3 probability that 600 people will be saved* (see (1)) and *2/3 probability that 600 people will die* (see (2)) are assumed to be 'some will be saved' (see (3)) and 'some will die' (see (4)), respectively, rather than 'all will be saved' and 'all will die'.

2.2. Accounts of group 2: truth-conditional difference between the two frames

The so-called ambiguity hypothesis starts out from the conjecture that the description of the sure option of the deadly-disease scenario is incomplete (e.g., Kühberger, 1995; Kühberger and Tanner, 2010; Mandel, 2001). For example, the descriptions of Program A1 in (1) and Program B1 in (2) leave open the fate of the people who are not mentioned. Of course, it is plausible to assume that participants will infer for Program A1 that all of the 400 unmentioned people will not survive the disease, and for Program B1 that all of the 200 unmentioned people will not die from the disease. With these inferences, the two different frames are truth-conditionally equivalent. However, the incompleteness of the description leaves room for alternative inferences, or rather for wild guesses. For example, people might act on the assumption that some of the 200 people who are not mentioned in the *survive*-frame description of Program A1 (see (1)) will also survive and/or the assumption that some of the 400 people who are not mentioned in the *die*-frame description of Program B1 (see (2)) will also die from the disease. If so, then the truth conditions of the two different frames diverge, as Program A1 and Program B1 involve two different outcomes (200 + n out of 600 lives saved ≠ 400 + n out of 600 lives lost). Along these lines of reasoning, it could be argued that risky-choice framing effects are simply due to the fact that the given frames are not necessarily conceived as being truth-conditional equivalent. Accordingly, framing effects should be eliminated when the outcome of the sure option is fully specified, as in (5). In line with this prediction, no framing effect was found in studies employing full-fledged descriptions of the sure option (Druckman, 2001; Kühberger 1995; Mandel, 2001, 2014)[4].

(5) a. If Program A1 is adopted, then 200 people will survive, and 400 people will not survive.
    b. If Program B1 is adopted, then 400 people will die, and 200 people will not die.

[4] Note that this finding is neither in conflict with the fuzzy-trace theory account of framing effects, nor with any of the accounts described below (lower-bound reading, information leakage, argumentative-orientation, alignment assumption) considering that the variants of complete descriptions of the sure option do not differ in the variables considered decisive in these accounts.

A notable variant of the ambiguity hypothesis relates to the interpretation of the numerals that are contained in the descriptions of the sure options. Although there is no generally accepted treatment of numerals, it is uncontroversial that bare numerals can receive different readings (e.g. Breheny, 2008; Carston, 1998; Geurts, 2006; Horn, 1992; Kennedy, 2015). The issue of numeral interpretation has largely been ignored in research on framing effects. Yet, as has been pointed out by Mandel (2014; see also Kühberger, 1995), the readings that participants of framing studies assign to the given numerals are critical with regard to the interpretation of framing effects. Mandel (2014) proposes a lower-bound-reading account and assumes a tendency to assign a lower-bound reading to the numerals in the (not fully specified) sure options. If true, then the positively and negatively framed descriptions are not truth-conditionally equivalent (at least 200 out of 600 lives saved ≠ at least 400 out of 600 lives lost), offering a simple account of framing effects. Mandel (2014) investigated the role of numeral interpretation in a series of experiments. In one of the experiments, participants had to indicate their interpretation of the given numerals by choosing between three alternatives: 'exactly', 'at least', 'at most'. The majority of participants (64%) indicated a lower-bound interpretation of the numeral. Moreover, a standard framing effect obtained only for this subgroup of participants. However, these findings do not provide unequivocal evidence for the lower-bound-reading account, due to two potentially critical methodological aspects. First, the forced choice task did not include an option for indicating an approximate reading of the numerals. This is problematic, considering that it is not unlikely that round numbers such as 200 and 400 are interpreted as approximate estimates (e.g., Krifka, 2009). Second, the numeral interpretation assessment immediately followed the task of choosing between the sure and risky option. Hence, the just-made choice might have influenced participants' indication of the numeral interpretation (e.g., in terms of a justification of the choice)[5]. In two other experiments, Mandel (2014) found that the framing effect was absent, when a precise reading of the numerals was enforced by modifying them with *exactly*. This finding is consistent with the lower-bound-reading account. However, there is a conflicting finding from a study in which a strong framing effect obtained when the numerals were likewise modified with *exactly* (Chick, Reyna and Corbin, 2016).

2.3. Accounts of group 3: implicit-information difference between the two frames

The information-leakage account (McKenzie and Nelson, 2003; Sher and McKenzie, 2006) differs from the preceding accounts in two aspects. Firstly, it neither questions the truth-conditional equivalence of differently framed descriptions nor does it assume that they are fully equivalent. Rather, the key assumption of the information-leakage account is that differently framed descriptions are not information equivalent in the sense that they implicitly convey different information. Secondly, the information leakage account adopts a somehow communicative perspective by assuming that listeners draw inferences as to why the speaker chose a given frame. Thus, the use of a particular frame is assumed to "leak" information on

[5] I am currently conducting an experiment with a numeral-interpretation assessment with four alternatives and with distractor tasks in between the task of choosing between the intervention programs and the assessment of the numeral interpretation. The preliminary results are inconsistent with the lower-bound-reading account. The vast majority of participants indicated that they interpreted the numerals with a precise reading (79%; approximate: 12%; lower bound: 6%; upper bound: 3%). Moreover, a framing effect obtained for all participants as well as for the subgroup of participants who indicated a precise reading.

the speaker's state of mind. More specifically, the speaker's choice of a frame is assumed to be affected by whether and how the to be described state of affairs deviates from a reference point, e.g., from expectations and/or the standard in the given domain. Consider the outcome of a novel medical treatment that could either be described in terms of the survival rate or in terms of the mortality rate. According to the information-leakage account, a speakers' choice between these frames depends on how the outcome of the new medical treatment differs from a reference point, e.g., the outcome of the standard medical treatment, such that she will select the frame that involves an increased rate relative to a reference point. For example, she will use a *survive*-frame as in (6a) rather than a *die*-frame as in (6b), if the survival rate of the standard treatment is less than 50% and vice versa if the standard treatment has a mortality rate less than 50%.

(6) a. 50% of patients with the new treatment survive.
    b. 50% of patients with the new treatment die.

According to the information-leakage account, framing effects arise because the two frames convey different implicit information as to how the options differ from the reference point. From the *survive*-frame, it can be inferred that more lives will be saved than with the reference point, whereas from the *die*-frame, it can be inferred that more lives will be lost than with the reference points. Empirical evidence supports the assumption that frame choice depends on how the to be described state of affairs deviates from a reference point (McKenzie and Nelson, 2003; Sher and McKenzie, 2006). Additional findings suggest that the effect of reference point on frame selection goes along with corresponding inferences on the listener's side (McKenzie and Nelson, 2003; Sher and McKenzie, 2006). For example, when being presented with a *survive*-frame as in (6a) participants were more likely to assume that the new medical treatment had a higher survival rate than the old treatment (McKenzie and Nelson, 2003). However, though these findings are consistent with the underlying assumptions of the information-leakage account, they do not provide direct evidence that framing effects emerge from reference-point inferences.

The argumentative-orientation account (Holleman and Pander Maat, 2009) is similar in spirit to the information leakage account as it also explains framing effects in terms of implicit information. However, the two accounts differ, in that the argumentative-orientation account focuses on the role of the communicators' intentions, which are neglected in the information leakage account. Holleman and Pander Maat couch their account in terms of generalized conversational implicatures. They assume that speakers' frame selection is guided by their argumentative orientation, i.e., by the direction of the conclusion the listeners are intended to draw from the utterance. Complementary, listeners make argumentative-orientation inferences. That is, based on the uttered frame, they infer the direction of the conclusions intended by the speaker. [6] For example, framing the outcome of an exam in terms of passing rate rather than failure rate may result in different argumentative-orientation inferences, e.g., with regard to the easiness/difficultness of the exam. The strength of argumentative-orientation inferences is assumed to be affected by the markedness of the chosen frame. It is stronger for marked

[6] A similar view on framing is taken by Mercier and Sperber (2011), who interpret framing effects as support for their argumentative theory.

frames than for unmarked frames. [7] The argumentative-orientation account implies that framing effects arise because the two frames trigger different argumentative-orientation implicatures, e.g. that the conclusion intended by the speaker is either to choose (*survive*-frame) or not to choose the option (*die*-frame). Holleman and Pander Maat report experimental findings that are consistent with the notion that a speaker's argumentative orientation affects which frame she chooses, as well as findings that are in line with the converse notion, that a given frame conveys implicit information on the speaker's intended argumentative conclusion. Yet, these findings do not directly show that the source of framing effects lies in argumentative-orientation implicatures.

3. Alignment-assumption account

Imagine a scenario where 600 people were infected by a potentially deadly disease and 200 of the 600 people survived the disease and the remaining 400 did not survive the disease. To put it in other words, 400 of the 600 people died of the disease and the remaining 200 did not die of the disease. In this scenario, (7a) and (7b) can be considered to be truth-conditionally equivalent. Yet, when they are embedded under the positively evaluative predicate *good* the resulting assertions (8a) and (8b) appear contradictory.

(7) a. Two-hundred people survived the disease.
 b. Four-hundred people died of the disease.

(8) a. It's good that 200 people survived the disease.
 b. It's good that 400 people died of the disease.

To solve this semantic problem, Geurts (2013) proposes that expressions like *good* trigger the adoption of an alignment assumption. [8] More specifically, *good*(φ) presupposes that φ's alternatives (Alt(φ)) are ordered on a qualitative "goodness" scale. If these alternatives can also be ordered on a quantitative scale in terms of entailment-based strength, then the two scales are assumed to be aligned, as indicated by the formulation of the alignment assumption in (9).[9] For the evaluative statements in (8), the alignment assumption implies the inferences in (10), which clearly contradict each other. Thus, Geurts' notion of an alignment assumption explains why one cannot consistently endorse both (8a) and (8b).

(9) $\forall\psi, \psi' \in \mathrm{Alt}(\varphi), \psi > \psi' \rightarrow \psi \gg \psi'$ $>$: 'stronger than'; $\gg$: 'better than'

(10) a. $n + 1$ survived $\gg$ n survived
 b. $n + 1$ died $\gg$ n died

[7] Holleman and Pander Maat assume that markedness of a frame is determined by its valence (positive = unmarked; negative = marked) and its goal salience in a given scenario (goal consistent = unmarked (e.g., full in a filling scenario; empty in an emptying scenario); goal inconsistent = marked (e.g., full in an emptying scenario; empty in a filling scenario)).

[8] He suggests that "the core meaning of 'good' is something like the following: 'It's good that φ' means that φ ranks sufficiently highly on the relevant qualitative scale which orders Alt(φ)" (Geurts, 2013: p. 10).

[9] In Geurts (2009), two weaker versions of the alignment assumption are discussed.

The notion of an alignment assumption also explains why the two evaluative statements in (11), in which the numerals are modified with the comparative modifiers *more than* and *fewer than*, do not seem contradictory. The two inferences in (12) are compatible. (11b), with the downward-entailing *fewer than*, differs from (8a), (8b), and (11a), in that its alternatives become stronger with decreasing rather than increasing number.

(11) a. It's good that more than 200 people survived the disease.
     b. It's good that fewer than 400 people died of the disease.

(12) a. more than $n + 1$ survived $\gg$ more than n survived
     b. fewer than n died $\gg$ fewer than $n + 1$ died

Geurts applies his alignment-assumption solution of a semantic problem to framing effects by the following line of reasoning: Judgments and decisions do not only reflect the evaluation of a particular option, but also the evaluation of its counterfactual alternatives. The choice task in framing studies involves an evaluation process which can be expected to be affected by the alignment assumption. A person who is presented with the *survive*-frame of the sure option (Program A1) will evaluate the option as positive to some degree (and would rate an option with a higher survival rate as more positive). However, when instead being presented with the *die*-frame of the sure option (Program B1), the evaluation will tend to be negative, as a positive evaluation would involve the alignment-assumption inference that a higher number of lives lost would be more positive. Thus, according to the alignment-assumption account, the framing effect is driven by the evaluation of the sure option. Indeed, there is experimental evidence that the framing effect is not due to having to choose between a sure and a risky option, but rather is due to an attractiveness difference between the two variants of the sure option (Kühberger and Gradl, 2013; Peters and Levin, 2008).

4. Testing two predictions of the alignment assumption account

Geurts' (2013) alignment-assumption account radically differs from other accounts of framing effects. To my knowledge, it is not in conflict with the extant findings. Rather, it opens up a new perspective and leads to novel predictions. In the following, I will address two predictions that relate to the effect of modifying the numerals in the two description versions of the sure option with an upward-entailing comparative quantifier (see (13a)) and a downward-entailing comparative quantifier (see (13b)).

(13) a. If Program A1 is adopted, more than 200 people will survive.
     b. If Program B1 is adopted, fewer than 400 people will die.

The alignment-assumption account predicts an interaction effect between the frame (*survive*/*die*) and the way in which the outcome is stated, i.e., with modified numerals as in (13) or with bare numerals as is common in framing studies (see (1) and (2)). The interaction should affect the evaluation of the sure option (see Prediction 1 in (14)) and the pattern of choices of the sure and risky option (see Prediction 2 in (15)).

(14) Prediction 1
The two differently framed descriptions of the sure option in (13) with modified numerals will not result in different evaluative ratings, because the alignment-assumption inferences are compatible. In contrast, with unmodified numerals, the *survive*-variant will be rated more positive than the *die*-variant, because a positive evaluation of the *die*-variant would involve the alignment-assumption inference that a higher number of lives lost would be more positive.

(15) Prediction 2
Different from the standard descriptions of the sure options, i.e., with bare numerals, no framing effect will occur when the numerals in the sure options are modified as in (13).

The predictions were tested in two experiments. The experiments were conducted in German and were implemented as web-based experiments. Experiment 1 addressed Prediction 1 and employed a judgment task; Experiment 2 targeted Prediction 2 and employed a choice task. In both experiments, participants were presented with a cover story (see (16)) that corresponded to the preamble used in the study by Tversky and Kahneman (1981).

(16) Cover story in Experiment 1 and 2
Stellen Sie sich die folgende Situation vor: Die Gesundheitsbehörde einer Kleinstadt bereitet sich auf den Ausbruch einer hochansteckenden Krankheit vor, durch die voraussichtlich 600 Menschen getötet werden. Es gibt eine Vielzahl von unterschiedlichen Programmen zur Bekämpfung der Krankheit, zwischen denen sich die Gesundheitsbehörde entscheiden muss.

'Imagine the following situation: The health authority of a small town is preparing for the outbreak of a highly contagious disease, which is expected to kill 600 people. There are a variety of different programs to combat the disease between which the health authority must decide.'

4.1. Experiment 1

Experiment 1 was designed to test Prediction 1. That is, it investigated whether there is an interaction effect of frame (*survive*/*die*) and numeral (unmodified/modified) on the evaluation of the sure option. The four versions of the sure option in (17) were presented to participants as different intervention programs within the deadly-disease scenario. Their task was to rate each intervention program with regard to how good or bad they consider it to be.

(17) a. Bei Anwendung von Programm A1 werden 200 Menschen überleben.
'If Program A1 is adopted, 200 people will survive.'

b. Bei Anwendung von Programm B1 werden 400 Menschen sterben.
'If Program B1 is adopted, 400 people will die.'

a'. Bei Anwendung von Programm A1 werden mehr als 200 Menschen überleben.
'If Program A1 is adopted, more than 200 people will survive.'

b'. Bei Anwendung von Programm B1 werden weniger als 400 Menschen sterben.
'If Program B1 is adopted, fewer than 400 people will die.'

4.1.1. Method

Participants. The participants of Experiment 1 and Experiment 2 were native speakers of German who were recruited from the student population of Berlin and Potsdam. All participants gave informed consent for participation and participated in exchange for the chance to win € 25 in a raffle. Eighty students (18 to 36 years, M = 22.11; 57 female) participated in Experiment 1. The data of six additional participants were excluded from the analyses because they were not native speakers of German.

Design. Experiment 1 employed a 2x2 within-subject design with the factors NUMERAL (unmodified/modified) and FRAME (*survive/die*).

Materials and Procedure. In the instruction, participants were asked to imagine the scenario of an imminent outbreak of a deadly disease. They were told that there are several intervention programs to combat the disease and that their task was to indicate for each program how good or how bad they judge it to be. There were four experimental trials and 28 filler trials, each with a different intervention program. In all 32 trials, participants were asked to judge the given intervention program on an evaluative rating scale ranging from 1 (very bad) to 7 (very good). In the experimental trials, the description of the intervention programs was based on the sure options of the study by Tversky and Kahneman (1981). The four experimental trials resulted from the 2x2 conditions from the design of Experiment 1 (see (17)). Thus, in two experimental trials, the outcome of the intervention program–in terms of the amount of lives either to be saved or lost–was indicated with an unmodified numeral. In the other two experimental trials, the numerals were modified, i.e., by the upward entailing comparative quantifier *mehr als* ('more than') in the *survive*-frame and by the downward entailing comparative quantifier *weniger als* ('fewer than') in the *die*-frame. In half of the filler trials, the intervention program was described with the *survive*-frame; in the remaining half of the filler trials, it was described with the *die*-frame. The intervention programs in the filler trials differed from those in the experimental trials in the amount of lives to be saved or lost (e.g. ... *werden 100 Menschen sterben* [‘… 100 peole will die’] or in aspects of the description, such as different modifying expressions (e.g. *exact* [‘exactly’], *ungefähr* [‘approximately’], *mindestens* [‘at least’]), stating the outcome in terms of percentages (e.g. ... *50% überleben* [‘… 50% survive’] or stating the probability of the outcome (e.g. ... *werden mit einer Wahrscheinlichkeit von 2/3 alle sterben* [‘… there is a probability of 2/3 that all will die’]. Participants were randomly assigned to one of 24 different orders of presentation of the experimental and filler trials. The two frame versions of the experimental trials in either of the two modification versions were always intervened with a sequence of 15 other trials. The experimental session lasted approximately 15 minutes.

4.1.1. Results

Table 1 shows the median ratings in the four conditions of Experiment 2. The rating data were analyzed by using a cumulative link mixed model for ordinal data (R package ordinal) with NUMERAL and FRAME as fixed effects and with participants as random effect. For both fixed factors, sum coding was used (+.5 for 'unmodified' and 'survive'; -.5 for 'modified' and 'die'). The analysis yielded main effects of NUMERAL (b = .41, SE = .15, z = 2.82, p < .01) and FRAME (b = -1.65, SE = .32, z = -5.15, p < .01). These were qualified by a significant interaction of the two factors (b = .69, SE = .21, z = 3.26, p < .001), consistent with Prediction 1. In order to break up the interaction, two separate analyses for the data subsets of the two NUMERAL conditions were conducted. The results of the analyses strengthen the evidence for Prediction 1. In the 'unmodified numeral' condition, the 'survive' version was significantly rated more positive than the 'die' version (b = -1.33, SE = .32, z = -4.19, p < .01). In the 'modified numeral' condition, the ratings did not differ in the two frames (b = -.25, SE = .29, z = -.85, p = .40).

	FRAME	
NUMERAL	'survive'	'die'
umodified	3	2
modified	3	3

Table 1: Median ratings in the four conditions of Experiment 1

4.2. Experiment 2

In Experiment 2, the prediction was tested that the occurrence of a framing effect depends on whether or not the numerals in the sure option are modified (Prediction 2), i.e., that a framing effect will occur with bare numerals, as in the standard description of the sure option, but not when the numerals in the sure options are modified as in (17a') and (17b'). To this end, Experiment 2 employed the standard choice task as in the classical study by Tversky and Kahneman (1981). That is, participants had to choose between two programs, one with a sure outcome and one with a risky outcome. There were four experimental choice tasks, implementing the four conditions addressed in Prediction 2. The four versions of the sure option were the same as in Experiment 1 (see (17)). When the numerals in the sure options were unmodified, the description of the corresponding risky options were German versions of the descriptions used in the study by Tversky and Kahneman (1981), as shown in (18a) and (18b). The sure options with modified numerals were paired with adjusted descriptions of the risky options. Without the adjustment, the expected value of the risky option in the *survive*-frame (200) would have been lower and the expected value of the risky option in the *die*-frame (400) would have been higher than the vague outcome of the sure options (*survive*-frame > 200; *die*-frame: < 400). In order to equal the expected value of the risky options as far as possible with the outcome of the corresponding sure option, the probability statements in the descriptions of the risky options were also modified by comparative quantifiers. That is, for the first mentioned outcome of the risky option, the probability statement was modified with *mehr als* ('more than') and for the second mentioned outcome it was modified with *weniger als* ('less than'), as shown in (18a') and (18b').

4.2.1. Method

<u>Participants</u> Sixty-one students (18 to 36 years, M = 21.79; 45 female) participated in Exper-

iment 2. The data of three additional participants were excluded from the analyses because they were not native speakers of German.

Design Experiment 2 employed a two-factorial within-subject design with the factors NUMERAL (unmodified/modified) and FRAME (survive/die).

(18) a. Bei Anwendung von Programm A2 werden mit einer Wahrscheinlichkeit von 1/3 600 Menschen überleben und mit einer Wahrscheinlichkeit von 2/3 wird niemand überleben.
'If Program A2 is adopted, there is a probability of 1/3 that 600 people will survive, and a probability of 2/3 that no one will survive.'

b. Bei Anwendung von Programm B2 wird mit einer Wahrscheinlichkeit von 1/3 niemand sterben und mit einer Wahrscheinlichkeit von 2/3 werden 600 Menschen sterben.
'If Program B2 is adopted, there is a probability of 1/3 that no one will die, and a probability of 2/3 that 600 people will die.'

a'. Bei Anwendung von Programm A2 werden mit einer Wahrscheinlichkeit von mehr als 1/3 600 Menschen überleben und mit einer Wahrscheinlichkeit von weniger als 2/3 wird niemand überleben.
'If Program A2 is adopted, there is a probability of more than 1/3 that 600 people will survive, and a probability of less than 2/3 that no one will survive.'

b'. Bei Anwendung von Programm B2 wird mit einer Wahrscheinlichkeit von mehr als 1/3 niemand sterben und mit einer Wahrscheinlichkeit von weniger als 2/3 werden 600 Menschen sterben.
'If Program B2 is adopted, there is a probability of more than 1/3 that no one will die, and a probability of less than 2/3 that 600 people will die.'

Materials and Procedure Participants were presented with the same scenario as in Experiment 1 (see (16)) and were given eight choice tasks. In each of the choice tasks, they had to choose between two intervention programs, one with a sure outcome and one with a risky outcome. The eight choice-task trials were intervened by eight distractor trials. In the distractor trials, participants were asked to name four words that begin or end with a given chain of two to three letters. The sequence of trials started with a distractor trial which was followed by an alternating presentation of the eight choice-task trials and the remaining seven distractor trials. Half of the choice-task trials were experimental trials; the other half were filler trials. The four experimental trials corresponded to the four conditions resulting from the design of Experiment 2 (see (17) and (18)). That is, there were two experimental trials with bare numerals, one in the *survive*-frame and one in the *die*-frame. In the two other experimental trials, the numerals were modified by a comparative quantifier, i.e., by *mehr als* ('more than') in the *survive*-frame of the sure option and by *weniger als* ('fewer than') in the *die*-frame of the sure option[10]. In the filler trials, all numerals were modified albeit differently than in the experimental trials (e.g. by *exact* ['exactly']). Two of the filler trials had a *survive*-frame; the other two fillers had a *die*-frame. The four filler choice tasks and the four experimental choice tasks

[10] In the risky options of the trials, the numerals indicating the probabilities of the two outcomes were modified by the two comparative quantifiers in such a way that the (vague) expected value of the risky options matched the outcome of the corresponding sure options (see (18a') and (18b')).

were presented in 24 different orders, which were randomly assigned to the participants. In between the two frame versions of the experimental choice tasks in either of the two modification versions, there were always three other choice tasks and four distractor tasks. The experimental session lasted approximately 15 minutes.

4.2.1. Results

Table 2 shows the proportion of sure-option choices in the four conditions of Experiment 2. The data were analyzed by using a generalized linear mixed model with a binomial logit function and with participants as random factor. There were two fixed factors, NUMERAL and FRAME, both with sum coding (+.5 for 'unmodified' and 'survive'; -.5 for 'modified' and 'die'). There was no main effect of FRAME (b = -.48, SE = .33, z = -1.44, p = .15) and a significant main effect of NUMERAL (b = 1.15, SE = .35, z = 3.29, p < .01). The latter was qualified by a significant interaction of both factors (b = -1.65, SE = .68, z = -2.43, p < .05). To examine the interaction, two separate analyses for the data subsets of the two NUMERAL conditions were conducted. In the 'unmodified numeral' condition, there was a significant effect of FRAME on the choice patterns (b = -1.48, SE = .56, z = -2.64, p < .01), i.e., in the 'survive' condition, the majority of participants (64%) chose the sure option, whereas in the 'die' condition, the majority of participants (57%) chose the risky option. In the 'modified numeral' condition, the choice pattern was not affected by the frame (b = .30, SE = .45, z = .66, p = .51), i.e., in the 'survive' condition as well as in the 'die' condition, most participants favoured the sure option over the risky option (see Table 2). This pattern of results is consistent with Prediction 2. A framing effect obtained for the 'unmodified numeral' versions of the description of the intervention programs. In contrast, for the 'modified numeral' versions, there was no framing effect.

	FRAME	
NUMERAL	survive	die
unmodified	64%	43%
modified	69%	74%

Table 2: Proportion of sure-option choices in the four conditions of Experiment 2

4.3. Discussion

In Experiment 1, no effect of frame (survive/die) on evaluative ratings was found, and in Experiment 2, no framing effect on the choice patterns for the sure vs. risky option occurred, when the numerals indicating the number of lives saved and lives lost were modified with the upward-entailing comparative quantifier *mehr als* and the downward-entailing comparative quantifier *weniger als*, respectively. In contrast, with a standard description of the options, i.e., with unmodified numerals, the *survive*-version of the sure option was rated significantly more positive than the *die*-version (Experiment 1). In addition, there was a significant framing effect with unmodified numerals in that the sure option was preferred in the 'survive' condition and dispreferred in the 'die' condition (Experiment 2).

The interpretation of null effects can be tricky. However, for two reasons it seems unlikely that the null effects obtained with the modified numerals are due to a failure to detect an effect of the frame manipulation when in truth there was one. First, the null result was observed in two experiments. Second, the fact that there were significant effects with unmodified numerals indicates that the materials and methods were sufficiently sensitive to reveal an effect of the manipulated frame.

The present findings provide preliminary experimental evidence for the two predictions that were derived from the alignment-assumption account. Within that account, the findings can be interpreted in terms of alignment-assumption inferences that come along with valence evaluations. Hence, the absence of effects of the frame manipulation with modified numerals can be attributed to that a positive evaluation of the sure option for both frames involves alignment-assumption inferences that conform to human convictions (the more lives saved/the less lives lost the better). [11] By the same token, the presence of effects of the frame manipulation with unmodified numerals can be explained by that the alignment-assumption inferences involved with a positive evaluation of the sure option are in concord with human convictions for the *survive*-frame but are in conflict with those for the *die*-frame. [12]

In the following, I will consider how the present findings could be captured by other accounts of framing effects (see Section 2), particularly the finding that the framing effect was absent when the numerals in the *survive*-version and the *die*-version were modified with an upward-entailing and downward-entailing comparative quantifier, respectively.

According to prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1981), the source of framing effects lies in the different reference outcomes being induced by the alternative frames, such that an outcome that is described with the *survive*-frame is perceived as a gain whereas an outcome that is described with the *die*-frame is perceived as a loss. To account for the present findings within the framework of prospect theory, one might conjecture that the reference outcome, relative to which the outcome of a given option is evaluated, is not only determined by the *survive*-frame vs. *die*-frame, but crucially also by the presence of expressions such as comparative quantifiers. More specifically, the outcome description *more than 200 people will survive* might induce a reference outcome of 200 lives saved and the outcome description *fewer than 400 people will die* might induce a reference outcome of 400 lives lost, such that for both description variants, the outcome is perceived as a gain.

In fuzzy-trace theory (Reyna and Brainerd, 1991), framing effects are assumed to emerge from gist representations that do not contain the numerical information. To capture the present findings, one could speculate that the gist representations for the *survive*-version and the *die*-version of the sure option with modified numerals correspond to something like (19a) and

[11] The inferences for the *survive*-version and the *die*-version with modified numerals correspond to (ia) and (ib).

(i) a. 'more than $n + 1$ lives saved' is better than 'more than n lives saved'
    b. 'fewer than n lives lost' is better than 'fewer than $n + 1$ lives lost'

[12] For bare numerals, the inferences for the *survive*-version and the *die*-version correspond to (ia) and (ib).

(i) a. '$n + 1$ lives saved' is better than 'n lives saved'
    b. '$n + 1$ lives lost' is better than 'n lives lost'

(19b), respectively. However, to explain the present findings for modified numerals, it must additionally be assumed that the gist representations for the two versions do not give rise to (substantially) different valence evaluations.

(19) a. If Program A1 is adopted, more people will survive.
b. If Program B1 is adopted, fewer people will die.

The ambiguity-hypothesis (e.g. Kühberger and Tanner, 2010) claims that framing effects have their source in the incompleteness of the description of the sure option. It is assumed that the incomplete descriptions allow for wild guesses as to the fate of the unmentioned people with different outcomes for the two frames, such that the two options are not truth-conditionally equivalent. To capture the present findings within the framework of the ambiguity hypothesis, one either must assume that there are no wild guesses with modified numerals or that the guesses have similar outcomes for the *survive*-version and the *die*-version of the sure option.

The lower-bound-reading account of framing effects (Mandel, 2014) also attributes framing effects to a truth-conditional difference between the *survive*-version and the *die*-version of the sure options. More specifically, it is assumed that the numerals that indicate the amount of lives saved or lost receive a lower-bound reading. Apparently, this account can readily explain the present findings by the non-controversial assumption that the reading of numerals is constrained when they are modified by comparative quantifiers. However, to capture the present findings within the lower-bound-reading account, one has to make the additional assumption that the *survive*-version with an upward-entailing comparative quantifier and the *die*-version with a downward-entailing comparative quantifier are either equivalent or that that they differ less than the standard versions with bare numerals to which a lower-bound reading is assigned.

According to the information-leakage account (e.g. McKenzie and Nelson, 2003), framing effects arise because descriptions with different frames are not information equivalent. It is assumed that the *survive*-version and the *die*-version of the sure options convey different implicit information with regard to how their outcome deviates from a reference point. To cover the present findings, a core assumption of the account must be revised, i.e., the notion that solely the frame is decisive has to be abandoned. In order to explain the findings within the framework of the information-leakage account, one has to assume that expressions such as comparative quantifiers also bear on reference-point inferences. Regarding the case at hand, one might hypothesize that the outcome description *more than 200 people will survive* implicitly conveys a reference point of 200 surviving people and that the outcome description *fewer than 400 people will die* implicitly conveys a reference point of 400 dying people.

The argumentative-orientation account (Holleman and Pander Maat, 2009) also acts on the assumption that framing effects can be attributed to a difference in implicit information between distinct frames. It is assumed that different frames trigger different argumentative-orientation implicatures. To capture the present findings within the framework of the argumentative-orientation account calls for assumptions as to whether and how the presence of comparative quantifiers is pivotal in prompting argumentative-orientation implicatures.

In summary, the findings for modified numerals from the present study are consistent with predictions that directly follow from the alignment-assumption account. The findings can be captured by other accounts of framing effects, albeit only by making additional, post-hoc assumptions. An exception in this regard is the lower-bound-reading account. However, as was mentioned in Section 2.2, studies on the role of numeral interpretations for framing effects yielded mixed results. It remains an empirical task to reconcile the equivocal findings and to further explore the validity of the lower-bound-reading account.

5. Conclusion

Framing effects have been demonstrated in numerous experimental studies. Yet, their source is still a matter of controversy. There is a wide range of different accounts of framing effects. The accounts are not mutually incompatible, and it is likely that multiple factors may be involved. The very basis of framing effects, however, are differences in linguistic input. Hence, pushing the advancement of semantic-pragmatic explanations is highly desirable. The alignment-assumption account proposed by Geurts (2009, 2013) offers such an explanation. It radically differs from other accounts and opens up a new perspective on framing effects by explaining them in matters of a counterfactual systematicity of judgments and choices. The findings of the present experiments provide first empirical support for the alignment-assumption account by confirming two directly derivable predictions. The predictions, which pertained to effects of upward- vs. downward entailing comparative quantifiers, do not follow from other accounts of framing effects, which are challenged by the present findings.

Obviously, the scope of the present study is limited. It remains to be investigated whether people actually act from the alignment assumption[13] and whether or not the assumption is an internalized heuristic. Such kind of investigations are specifically relevant as to the validity of the alignment-assumption account. However, their findings might be of wider relevance, i.e., to research on the semantics of evaluative predicates and to research on entailment reasoning.

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[13] The initial results of an own ongoing pilot study are promising in this regard. Participants overwhelmingly agreed with statements that corresponded to alignment-assumption inferences from evaluative assertions on fictitious issues for which they had no prior knowledge (e.g. *It is good that 36 of the tested shampoos contained Burarlin*), and they overwhelmingly disagreed with statements that were in conflict with the inferences.

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Interpreting polarity-ambiguous propositional anaphors with negative antecedents: Some experimental results[1]

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Abstract. The starting point of the present paper is the assumption that negative sentences introduce two propositional discourse referents, one for the negative proposition and one for the negated, positive proposition. Both propositional discourse referents can be picked up by propositional anaphors, resulting in potential ambiguity (e.g. Ernie: *Cookie Monster didn't eat the cookie*. Bert: *Kermit believes that*$_{\text{[CM didn't eat the cookie / CM ate the cookie]}}$). We report an explorative experimental study on the interpretation of propositional anaphors that are polarity-ambiguous between a resolution with the negative and the positive propositional discourse referent. We employed two different methods, a direct task (forced choice) and a more indirect task (acceptability rating), which yielded mixed results. Taken together, the findings of our study point to a preference for resolving polarity-ambiguous propositional anaphors with the negative propositional discourse referent and they demonstrate the necessity of methodological variety.

Keywords: propositional anaphors, negation, anaphoric ambiguity, anaphora resolution.

1. Introduction

Pronouns and demonstratives such as English *it* and *that* can anaphorically refer to a proposition being introduced in the preceding discourse (e.g. Asher, 1986; Cornish, 1992; Geurts, 1998) by picking up a salient discourse referent that is anchored to that proposition, i.e. a *propositional discourse referent*. For example, A's utterance in (1) introduces the proposition 'that Spencer stole the painting' and the demonstrative in B's response targets the propositional discourse referent for that proposition.

(1) A: Spencer stole the painting.
B: Louise believes that.

This paper addresses the case of propositional anaphors with a negative clause in the preceding context. Krifka (2013) proposes that clauses with sentential negation introduce two propositional discourse referents, one propositional discourse referent for the negative proposition, henceforth NEGDR, and a second propositional discourse referent for the positive proposition in the scope of the negation operator, henceforth POSDR (see also Snider, 2017). This proposal accounts for the observation that propositional anaphors can pick up the NEGDR as well as the POSDR. Consider the dialogue in (2) with two different responses to A's assertion.

(2) A: Spencer didn't steal the painting.
B: Katherine believes that$_{\text{NEGDR}}$, too.
B': But Louise believes that$_{\text{POSDR}}$.

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A's negative assertion is assumed to introduce the NEGDR 'that it is not the case that Spencer stole the painting' and the POSDR 'that Spencer stole the painting'. In (2B), the propositional anaphor *that* picks up the NEGDR, resulting in the interpretation that Katherine believes that Spencer did not steal the painting. In contrast, the propositional anaphor *that* in (2B') picks up the POSDR, resulting in the interpretation that Louise believes that Spencer stole the painting.

Yet, anaphoric reference to POSDRs is restricted. For instance, it is not felicitous when the propositional anaphor is the internal argument of a factive predicate such as *know*. The demonstrative *that* in (3B) can felicitously pick up the NEGDR but not the POSDR.[2] There are further factors that may constrain the felicity of anaphorically picking up the NEGDR and the POSDR, such as tense and modality and the possibility of accommodation (see Meijer, 2016; Meijer and Repp, 2017). However, with non-factive predicates, such as the belief verb in (3B') and the reporting verb in (3B''), the propositional anaphor *that* can in principle be felicitously resolved with both, the NEGDR and the POSDR. B's response in (3B') can either be read as 'Howard believes that Spencer didn't steal the painting' (NEGDR resolution) or as 'Howard believes that Spencer stole the painting' (POSDR resolution). By the same token, B's response in (3B'') can either be read as 'Howard told me that Spencer didn't steal the painting' (NEGDR resolution) or as 'Howard told me that Spencer stole the painting' (POSDR resolution).

(3) A: Spencer didn't steal the painting.
B: Katherine knows that$_{\text{NEGDR/\#POSDR}}$.
B': Howard believes that$_{\text{NEGDR/POSDR}}$.
B'': Howard told me that$_{\text{NEGDR/POSDR}}$.

Hence, following a negative antecedent clause, utterances with a propositional anaphor as the internal argument of a non-factive predicate are polarity-ambiguous; they can either receive a NEGDR reading or a POSDR reading. The intended reading can be brought out by adding additional material to the utterance, such as an additive particle (e.g. *Howard believes that, too*) or an adversative adverb (e.g. *But Howard told me that*). Also, it may be inferable from the context, common ground, or a continuation sentence (e.g. *Howard told me that. He thinks that Spencer is innocent/guilty*). However, in the absence of any overt material or implicit information that indicates the intended reading, the propositional anaphor is truly ambiguous between a NEGDR and a POSDR resolution. Just as with ambiguous nominal anaphors, there may be a default preference for resolving ambiguous propositional anaphors with the most salient discourse referent (e.g., Ariel, 1990; Gundel, Hedberg, and Zacharski, 1993).

For nominal discourse referents, several saliency-affecting factors have been identified, such as animacy, syntactic function, and order of mention (see Garnham, 2001, for an overview). For obvious reasons, most of these factors are not applicable to the issue of the relative saliency of the two propositional discourse referents being introduced by a negative utterance,

[2] Note, that according to some authors (e.g. Asher, 1993; Peterson, 1982), the *that* in (3B) does not refer to a proposition but to a different ontological type, i.e. a fact. However, here we will not dwell into this distinction but rather follow Snider (2017) in following Frege (1918) in the view that a fact is a proposition that is supposed to be true.

NEGDR and POSDR. A notable exception is constituent embedding, a factor that has been shown to affect the saliency of nominal discourse referents. The findings of an experimental study on complex DPs by Gordon, Hendrick, Ledoux, and Yang (1999) indicate that discourse referents from non-embedded complex constituents are more easily accessible than discourse referents from embedded constituents. Reading times for clauses containing a pronoun were found to be shorter when the pronoun referred to an entire complex DP than when it referred to a component of the complex DP. Experimental results of Frazier and Clifton (2005) indicate an accessibility difference between matrix clause material and complement clause material, suggesting that the effect of embedding on saliency is not restricted to the level of nominal discourse referents.

Applying the findings of an effect of embedding on saliency to the case at hand leads to the assumption that the NEGDR is more salient than the POSDR, as the former is introduced by a non-embedded constituent, whereas the latter is introduced by an embedded constituent. A different (or additional) reason for assuming a higher saliency of the NEGDR is that it is anchored to a proposition that is asserted in the preceding discourse whereas the POSDR is anchored to a negated proposition.

An alternative assumption emerges when considering that negative sentences are typically uttered in contexts in which the positive proposition is salient already. Accordingly, Krifka (2013) assumes the POSDR to be by default more salient than the NEGDR. In line with this assumption is a finding of psychological language-comprehension research that indicates that when processing a negative sentence, people first mentally represent the negated state of affairs, which corresponds to the positive proposition (Kaup, Yaxley, Madden, Zwaan, and Lüdtke, 2007).

In view of the arguments for the two reverse patterns of relative saliencies of the NEGDR and the POSDR, one could also entertain the assumption that the two propositional discourse referents do not differ in saliency. Though the POSDR may have an a-priori-saliency, it may still be as salient as the NEGDR rather than more salient taking into account that it is introduced by embedded material and is not asserted but negated.

Let's now turn back to the issue of the resolution of polarity-ambiguous propositional anaphors. The assumption of a higher saliency of the NEGDR leads to the prediction that polarity-ambiguous propositional anaphors are by default resolved with the NEGDR. In contrast, the assumption of a higher saliency of the POSDR predicts a default preference for the POSDR resolution. Finally, the assumption of equal saliencies does predict that there is no default preference for the resolution of polarity-ambiguous propositional anaphors.

The aim of the present, explorative study was to investigate how polarity-ambiguous propositional anaphors are resolved and to gain some insight whether there is a default preference. To this end, we conducted a series of three experiments.

2. Experiments

All three experiments were conducted in German. Between experiments, we varied the experimental method and/or aspects of the materials. In Experiment 1, we used a direct task to examine resolution preferences for polarity-ambiguous propositional anaphors. In Experiment 2, we employed a more indirect task to see whether the findings from Experiment 1 are generalizable to a more natural condition of language comprehension. Finally, Experiment 3 served as a control experiment with the aim of scrutinizing the justification of our conclusion drawn from the results of Experiment 2.

2.1. Experiment 1

In Experiment 1, we employed a two-alternative forced choice (2AFC) task to tap into participants' resolution of polarity-ambiguous propositional anaphors. The task of the participants was to indicate how they interpreted a sentence with an ambiguous propositional anaphor by choosing between two interpretation alternatives, one corresponding to the NEGDR resolution of the propositional anaphor and one corresponding to the POSDR resolution.

More specifically, the participants were presented with short dialogues consisting in an assertion and a response, as in (4). In all target items, the assertion had sentential negation. The response contained a propositional anaphor being realized by the German demonstrative pronoun *das* ('that'). The propositional anaphor constituted the internal argument of a non-factive verb, such that it could be resolved with either of the two propositional discourse referents introduced by the assertion, NEGDR or POSDR. To explore potential effects of information structure, we manipulated the word order of the response clause. The word order was either subject-verb-object (SVO; unmarked) or object-verb-subject (OVS; marked).

(4) **Sample target item of Experiment 1**

A: Tom hat die Tasche nicht gestohlen.
'Tom didn't steal the bag.'

B: a. Jenny glaubt das. (SVO)
'Jenny believes that.'

b. Das glaubt Jenny. (OVS)
'That is what Jenny believes.'

Interpretation alternatives for the 2AFC task
Jenny glaubt, dass Tom die Tasche nicht gestohlen hat. (NEGDR resolution)
'Jenny believes that Tom didn't steal the bag.'

Jenny glaubt, dass Tom die Tasche gestohlen hat. (POSDR resolution)
'Jenny believes that Tom stole the bag.'

2.1.1. Method

Participants Thirty-two students (18 to 40 years, *M* = 26.03; 22 female) from universities in Berlin and Potsdam participated in the experiment. All were native speakers of German. They gave informed consent for participation and received a monetary reimbursement.

Materials There were 24 target items and 36 filler items. Each item consisted in a dialogue between two interlocutors, A and B, which comprised two turns: an assertion and a response to it. All assertions pertained to fictitious entities to avoid effects of prior knowledge. The response was a sentence that included an ambiguous propositional anaphor. In all items, it was realized by the German demonstrative pronoun *das* ('that'), which always had object function.

In all target items, the assertion had negative polarity (see the sample item in (4)). There were two versions of the response sentence, differing only in word order. In the SVO version, the order was subject-verb-object; in the OVS version, it was object-verb-subject. Across target items, six different non-factive verbs were used in the response sentences; each of the six verbs was used in four target items. Three of the six verbs were belief verbs: *glauben* (‘to believe’), *denken* (‘to think’), *erwarten* (‘to expect’). The other three verbs were reporting verbs: *sagen* (‘to say’), *erzählen* (‘to tell’), *berichten* (‘to report’). The subject of the response sentence differed from the subject of the assertion and of the two interlocutors. It was a single person, a group of people, or a communication outlet (e.g. radio, newspaper), referred to by a proper name or a role description. Hence, B’s response to A’s assertion conveyed that some third party believes or reported either of the two propositional discourse referents introduced by A’s assertion, NEGDR or POSDR, depending on the resolution of the ambiguous propositional pronoun *das* ('that'). The interpretation alternatives, between which participants had to choose, were paraphrases of B’s responses, in which the ambiguous propositional pronoun was replaced with the wording of A’s assertion including the negation particle *nicht* ('not') (NEGDR resolution) or excluding the negation particle (POSDR resolution), respectively.

In half of the filler items, the word order in the response sentence was SVO; in the other half, it was OVS. Ten different verbs were used in the response sentences of the filler items: *glauben* (‘to believe’; n = 5), *denken* (‘to think’; n = 5), *erwarten* (‘to expect’; n = 5), *sagen* (‘to say’; n = 5), *erzählen* (‘to tell’; n = 5), *berichten* (‘to report’; n = 5), *befürchten* (‘to fear’; n = 2), *behaupten* (‘to claim’; n = 2), *lernen* (‘to learn’; n = 1), *schreiben* (‘to write’; n = 1). In all filler items, one of the two interpretation alternatives of the 2AFC task was a paraphrase of B’s responses in which the propositional pronoun was replaced with the wording of A’s assertion. In most of the 36 filler items (n = 23), A’s assertion was a complex structure with embedding and the ambiguous propositional pronoun in B’s response could either be resolved with the complex proposition or with the embedded proposition. For these filler items, the second interpretation alternative of the 2AFC task differed from the first one in that the ambiguous propositional pronoun was replaced with the wording of the embedded structure of A’s assertion. The embedding expression was a propositional attitude (n = 8), a modal adverb or verb (n = 7), the focus particle *auch* (‘too’; n = 4) or the focus particle *nur* (‘only’; n = 4). The embedded structures of A’s assertion in the eight items with a focus particle all contained the negation marker *nicht* (‘not’). In approximately one half of the remaining 13 filler items, A’s assertion contained the indefinite negative article *kein-* (‘none’; n = 7); in the second interpretation alternative of the 2AFC task, the negative indefinite article was replaced with its positive counterpart. In addition, there were filler items with lexical negation in A’s response (n = 4), i.e. an adjective with the negation morpheme *un-* (e.g., *ungesund* [‘unhealthy’]). In the second interpretation alternative of these filler items, the negative adjective was exchanged with its positive version (e.g., *gesund* [‘healthy’]). Finally, the remaining filler items (n =2) contained an embedding predicate with implicit negation (e.g., *verboten* [‘forbidden']) and had a second interpretation alternative, in which the predicate was exchanged with its positive counterpart (e.g., *erlaubt* ['permitted']).

Design and Procedure Experiment 1 employed a one-factorial within-subject design with the factor WORD ORDER (svo/ovs). The target items were assigned to two sets of twelve items each and participants were randomly assigned to two groups. The two conditions were allotted to sets and participant groups according to a Latin-square design. Thus, each participant was presented with each target item only once, in one of the two conditions, and each participant received twelve target items per condition. Target and filler items were presented to the participants in four different pseudorandomized orders. The experiment was run as a web study. Each item was presented in three parts. Participants were instructed to read each part carefully. By performing a mouse click, they proceeded to the next part, which was presented below the preceding part. Each item started with the presentation of A's assertion. This was followed by B's response. Then, the two interpretation alternatives of the 2AFC task were presented. The participants were instructed to click on the alternative that corresponded to their interpretation of B's response. The order of the two alternatives was varied across participants. The experimental session lasted approximately 30 minutes.

2.1.1. Results and discussion

Table 1 shows the proportion of choices of the two interpretation alternatives in the two WORD ORDER conditions of Experiment 1. The data were analyzed by using a generalized linear mixed model with a binomial logit function and with participants and items as random factors. The fixed factor was WORD ORDER with sum coding (+.5 for SVO and -.5 for OVS). The analysis revealed a significant effect of WORD ORDER (b = .64, SE = .22, z = 2.94, p < .01). The NEGDR interpretation alternative was chosen more often (and the POSDR interpretation alternative was chosen less often) in the OVS condition compared with the SVO condition. Separate χ^2-tests for the data sets of the SVO condition and OVS condition indicated that in both WORD ORDER conditions, the NEGDR interpretation alternative was chosen significantly more often than the POSDR interpretation alternative (SVO: $\chi^2 = 77.04$, $df = 1$, $p < .001$; OVS: $\chi^2 = 140.17$, $df = 1$, $p < .001$).

WORD ORDER: SVO		WORD ORDER: OVS	
NEGDR: 73%	POSDR: 27%	NEGDR: 80%	POSDR: 20%

Table 1: Proportion of choices of the two interpretation alternatives (NEGDR vs. POSDR) in the two WORD ORDER conditions of Experiment 1.

Overall, the results of Experiment 1 support the hypothesis that propositional anaphors that are ambiguous between a NEGDR resolution and a POSDR resolution are preferably resolved with the NEGDR. However, the results also suggest that the preference for NEGDR can be modulated by word order. The preference for NEGDR was found to be stronger with OVS word-order than with SVO word-order. One possibility to account for the effect of word order is in terms of topicalization. With OVS word-order (but not with SVO word-order), the discourse referent of the sentence-initial propositional pronoun may be conceived of as the topic of B's response. It has been proposed that embedded constituents and non-embedded constituents differ in their topicalizability, in that only non-embedded constituents are topicalizable in a subsequent utterance (Eckert, 1998: 213). If true, then this implies a higher likelihood of resolving the sentence-initial pronoun with the non-embedded NEGDR than with the embedded POSDR. Another possibility to explain the effect of word order is in terms of a deictic interpretation of the pronoun *das*. With OVS word-order (but not with SVO word-order), *das* may be conceived of as deictic reference, depending on the assignment of prosody when reading the sentence. Whenever the supposed reference of the pronoun is deictic rather than anaphoric, it refers to A's speech act, i.e. neither to POSDR nor to NEGDR. The deictic, speech-act reference, interpretation of *das* can be reconciled with the NEGDR interpretation alternative but not with POSDR interpretation alternative, which should result in more choices of the NEGDR interpretation alternative.

To further explore potential modulatory effects on participants' interpretation choices, we conducted two separate analyses, one for the data of target items with a reporting verb in B's response and one for the data of target items with a belief verb. Table 2 displays the proportion of choices, separately for the two verb types. For the reporting-verb data, there was no significant effect of WORD ORDER (b = .62, SE = .45, z = 1.38, p = .17); overall, the NEGDR interpretation alternative was chosen significantly more often than the POSDR interpretation alternative (χ^2 = 273.38, df = 1, p < .001). In contrast, the analysis of the belief-verb data revealed a significant effect of WORD ORDER on participants' choices of the NEGDR and POSDR interpretation alternatives (b = .76, SE = .26, z = 2.86, p < .01). In the SVO condition, the choice pattern for the belief-verb data did not differ from equal distribution (χ^2 = 1.33, df = 1, p = .25); only in the OVS condition, there was a significant preference for the NEGDR interpretation alternative (χ^2 = 21.33, df = 1, p < .001).

	WORD ORDER: SVO		WORD ORDER: OVS	
Reporting verbs	NEGDR: 91%	POSDR: 9%	NEGDR: 94%	POSDR: 6%
Belief verbs	NEGDR: 54%	POSDR: 46%	NEGDR: 67%	POSDR: 33%

Table 2: Proportion of choices of the two interpretation alternatives (NEGDR vs. POSDR) in the two WORD ORDER conditions of Experiment 1, separately for reporting and belief verbs

The results of the explorative post-hoc analyses for the two verb types suggest that the preference for the NEGDR resolution was stronger for the reporting verbs than for the belief verbs. This difference might be due to a discourse-functional difference between the responses with reporting verbs and belief verbs in the present dialogues. For the responses with reporting verbs, there may have been a pragmatic bias to conceive of them as providing evidence for or against the preceding utterance. For the responses with belief verbs, however, it can be assumed that there was no such bias (or at least a weaker one), considering that a belief does not implicate adequate evidence or good reasons. Taking the pragmatic bias with reporting-verb responses for granted, then with a NEGDR resolution of the propositional anaphor, B's response could be regarded as an affirmation of A's assertion, resulting in a smooth dialogue. However, with a POSDR resolution, B's response could be regarded as a rejection of A's assertion. Disagreements with another speaker are assumed to be unfavorable and marked (Krifka, 2013; see also Roelofsen and Farkas, 2015), which may have resulted in a particularly strong tendency to resolve the ambiguous propositional anaphor in reporting-verb responses with the NEGDR rather than with the POSDR, especially when considering that typical markers of disagreement, i.e. special intonation contour or a contradiction-signaling expression, were not present. This may explain the very high proportion of NEGDR-interpretation choices for the responses with reporting verbs. The absence of the WORD ORDER effect for the data of the reporting verbs might reflect a ceiling effect. However, the interpretation of the different result patterns for the reporting verbs and belief verbs is problematic due to the between-items variation of verb type. There may be other or additional differences between the two item groups that contributed to the difference in choice pattern.

Taken together, the findings of Experiment 1 suggest a preference for the NEGDR resolution of ambiguous propositional pronouns, which can be modulated by word order and possibly by verb type up to an equal distribution of NEGDR and POSDR resolutions. Hence, Experiment 1 does not provide unequivocal evidence for a default resolution preference for polarity-ambiguous propositional anaphors. Yet, the findings stem from a direct method, in which the ambiguity of the sentences with the propositional anaphor as well as the two possible interpretations were made explicit. The goal of Experiment 2 was to investigate the resolution of polarity-ambiguous propositional anaphors under a more natural condition of language comprehension.

2.2. Experiment 2

In Experiment 2, the 2AFC task was replaced with a task in which participants' attention is not drawn to the ambiguity of the propositional anaphor and its two possible interpretations. We employed the same basic material as in Experiment 1 but added a continuation sentence to B's response. The content of the continuation sentence was either consistent with the NEGDR resolution of the propositional pronoun in B's preceding utterance, as in (5B2a), or consistent with the POSDR resolution, as in (5B2b). The task of the participants was to judge the acceptability of the continuation sentence with respect to the preceding context. Our rationale behind employing this experimental task was that we considered the acceptability ratings to be indicative of the interpretation of the ambiguous propositional anaphor. Resolving the anaphor with the NEGDR should result in high acceptability ratings for the NEGDR-consistent continuation sentences and in low ratings for the POSDR-consistent (i.e. NEGDR-inconsistent) continuation sentences. By the same token, resolving the anaphor with the POSDR should result in high acceptability ratings for the POSDR-consistent continuation sentences and in low ratings for the NEGDR-consistent (i.e. POSDR-inconsistent) continuation sentences.

(5) **Sample target item of Experiment 2**

A: Tom hat die Tasche nicht gestohlen.
'Tom didn't steal the bag.'

B1: a. Jenny glaubt das. (SVO)
'Jenny believes that.'

b. Das glaubt Jenny. (OVS)
'That is what Jenny believes.'

B2: a. Denn sie ist von seiner Unschuld überzeugt. (NEGDR CONSISTENT)
'Because she is convinced of his innocence.'
b. Denn sie traut ihm nicht über den Weg. (POSDR CONSISTENT)
'Because she doesn't trust him an inch.'

2.2.1. Method

Participants Participants were 32 students (18 to 40 years, $M = 28.47$; 25 female) from universities in Berlin and Potsdam. All were native speakers of German, gave informed consent to participate in the experiment, and received a monetary reimbursement. The data of one additional participant were replaced because she/he was not a native speaker of German.

Materials The materials comprised 24 target items and 36 filler items. The items were the same as those of Experiment 1, with the exception that B's response was continued with an additional sentence. For all target items, there were two versions of the continuation sentence (see the sample item in (5)). In the NEGDR CONSISTENT version, the content of the continuation sentence was consistent with the NEGDR resolution of the preceding ambiguous propositional anaphor and inconsistent with the POSDR resolution. In the POSDR CONSISTENT version, the content of the continuation sentence was consistent with the POSDR resolution of the ambiguous propositional anaphor and inconsistent with the NEGDR resolution. For the filler items, there was only one version of the continuation sentence. In half of the filler items, the content of the continuation sentence was consistent with the content of the first interpretation alternative of Experiment 1; in the other half, it was consistent with the content of the second interpretation alternative.

Design and Procedure Experiment 2 employed a 2x2 within-subject design with the factors WORD ORDER (SVO/OVS) and CONTINUATION TYPE (NEGDR CONSISTENT/POSDR CONSISTENT). Participants were randomly assigned to four groups, and the experimental items were assigned to four sets. The four conditions resulting from the 2x2 design were allotted to sets and participant groups according to the counterbalancing schema for complex within-subject designs suggested by Pollatsek and Well (1995: 793). The procedure was the same as in Experiment 1, with the exception that the 2AFC task was replaced with a rating task. After reading B's response including the continuation sentence, participants again had to perform a mouse click, which caused the appearance of a 5-point rating scale. The scale ranged from 1 (very bad) to 5 (very good). The participants' task was to judge the acceptability of the continuation sentence by taking into consideration the preceding context.

2.2.1. Results and discussion

Table 3 shows the median ratings in the four conditions of Experiment 2. The data were analyzed by using a cumulative link mixed model for ordinal data (R package ordinal) with participants and items as random effects and WORD ORDER and CONTINUATION TYPE as fixed effects. For both fixed factors, sum coding was used (+.5 for SVO and NEGDR-CONSISTENT; -.5 for OVS and POSDR-CONSISTENT).

	WORD ORDER	
CONTINUATION TYPE	SVO	OVS
NEGDR CONSISTENT	5	5
POSDR CONSISTENT	1	1

Table 3: Median ratings in the four conditions of Experiment 2

The only significant effect was that of CONTINUATION TYPE (β = 3.75, *SE* = .20, z = 18.99, $p <$ .001). The ratings were significantly higher in the NEGDR-CONSISTENT condition than in the POSDR-CONSISTENT condition. The ratings were neither affected by WORD ORDER (β = .14, *SE* = .15, z =.98, p = .33) nor was there an interaction effect of CONTINUATION TYPE x WORD ORDER (β = -.04, *SE* = .29, z = -.14, p = .89).

The results of Experiment 2 point to a strong default preference for the NEGDR resolution of polarity-ambiguous propositional anaphors. The median of the ratings for the NEGDR-CONSISTENT continuations corresponds to the highest level on the rating scale whereas the median of the ratings for the POSDR-CONSISTENT continuations corresponds to the lowest level on the scale. This finding indicates that the propositional pronouns in the target items of Experiment 2 were overwhelmingly resolved with the NEGDR. Different from Experiment 1, there was no modulatory effect of word order. [3] Rather, the results point to a strong preference for the NEGDR resolution, irrespective of word order. Thus, it seems that the different methods – direct in Experiment 1 vs. indirect in Experiment 2–yielded mixed results.

In order to facilitate the comparison of the (descriptive) results of Experiment 1 with those of Experiment 2, we recoded the rating data of Experiment 2 according to the presumably underlying interpretation of the ambiguous propositional anaphor. For the NEGDR-CONSISTENT continuations, we considered ratings of 5 and 4 (highest level and second-to-highest level) as indicative of a NEGDR-interpretation (NEGDR-indicative ratings) and ratings of 1 and 2 (lowest level and second-to-lowest level) as indicative of a POSDR-interpretation (POSDR-indicative ratings). Conversely, for the POSDR-CONSISTENT continuations, we considered ratings of 5 and 4 as indicative of a POSDR-interpretation (POSDR-indicative ratings) and ratings of 1 and 2 as indicative of a NEGDR-interpretation (NEGDR-indicative ratings). Ratings of 3 (mid-level) were generally considered to be nonindicative, irrespective of the CONTINUATION TYPE. The distribution of NEGDR-indicative ratings and POSDR-indicative ratings and of nonindicative ratings in the two WORD ORDER conditions is displayed in Table 4a. Table 4b shows the distribution of the three rating categories separately for the two verb types.

The comparison of the proportions of the assumed interpretations in Experiment 2, as being derived from the rating recoding, with the proportions of interpretation-alternative choices in Experiment 1 (see Table 4a and 4b), is in line with the conjecture that the two experiments yielded mixed results regarding the interpretation of polarity-ambiguous propositional

[3] Different from Experiment 1, we did not conduct separate explorative analyses for the two verb types (reporting verbs vs. belief verbs) because of the low number of data points per participant and condition (n = 3) on which these analyses would have been based. Note, however, that the median ratings in the four experimental conditions of Experiment 2, were for both verb types equal to the overall median ratings as presented in Table 3.

anaphors. In Experiment 1, the NEGDR interpretation alternative was chosen more often (and the POSDR interpretation alternative was chosen less often) with OVS word-order than with SVO word-order. Furthermore, the preference for the NEGDR interpretation was considerably more pronounced for the subset of target items with reporting verbs rather than belief verbs as predicates. In contrast, the pattern of interpretations derived from the ratings of Experiment 2 did neither differ in the two word-order conditions (see Table 4a) nor was there a substantial difference between the two verb types (see Table 4b).

	WORD ORDER	
	SVO	OVS
NEGDR-indicative ratings	83% (Expt 1: 73%)	83% (Expt 1: 80%)
POSDR-indicative ratings	12% (Expt 1: 27%)	11% (Expt 1: 20%)
Nonindicative ratings	5%	6%

Table 4a: Proportion of NEGDR-indicative ratings, POSDR-indicative ratings, and nonindicative ratings in the two WORD ORDER conditions of Experiment 2; the percentages in parentheses show the proportion of choices of the corresponding interpretation alternative (NEGDR vs. POSDR) in Experiment 1.

	Reporting verbs	Belief verbs
NEGDR-indicative ratings	85% (Expt 1: 92%)	82% (Expt 1: 61%)
POSDR-indicative ratings	10% (Expt 1: 8%)	12% (Expt 1: 39%)
Nonindicative ratings	5%	6%

Table 4b: Proportion of NEGDR-indicative ratings, POSDR-indicative ratings, and nonindicative ratings in Experiment 2, separately for the two verb types; the percentages in parentheses show the proportion of choices of the corresponding interpretation alternative (NEGDR vs. POSDR) in Experiment 1.

An obvious reason for the different findings is the methodological difference between the two experiments. First, the direct task of Experiment 1 may have prompted special response strategies. Second, the indirect task in Experiment 2 may not have been suitable to investigate the interpretation of polarity-ambiguous propositional anaphors. We will turn back to the first issue in the Conclusion. The second issue was addressed in Experiment 3.

2.3. Experiment 3

The purpose of Experiment 3 was to scrutinize the rationale behind the method that was employed in Experiment 2. It was designed to examine whether it is justified to assume that the acceptability data for NEGDR- vs. POSDR-consistent continuations reflect the interpretation of the propositional anaphor in the preceding sentence. To this end, we investigated how the acceptability of the continuation sentences is judged when the resolution of the propositional anaphor is constrained to either the NEGDR or the POSDR. The material was the same as in Experiment 2, except that the two versions of B’s first response sentence did not differ in word order (constantly SVO) but in whether they enforced a NEGDR-interpretation or a POSDR-interpretation of the propositional anaphor, via the additive particle *auch* 'too' or the adversative adverb *aber* 'but', respectively (see (6)). The task of the participants was the same as in Experiment 2. If it is true that the acceptability judgments reflect the resolution of the propositional anaphor, then the two interpretation-manipulation conditions should yield reverse results. In the NEGDR-enforcing condition, the acceptability ratings should be high for the NEGDR-consistent continuations and low for the POSDR-consistent continuations, whereas in the POSDR-enforcing condition, they should be high for the POSDR-consistent and low for the NEGDR-consistent continuations.

(6) **B's first response sentence in the two interpretation-manipulation versions of Experiment 3 for the sample target item in (5)**

B1: a. Jenny glaubt das auch. (NEGDR-enforcing)
'Jenny believes that, too.'

B1: b. Jenny glaubt das aber. (POSDR-enforcing)
'But Jenny believes that.'

2.3.1. Method

Participants Participants were 34 students (18 to 40 years, $M = 25.79$; 27 female) from universities in Berlin and Potsdam. All were native speakers of German, gave informed consent to participate in the experiment, and received a monetary reimbursement.

Materials The materials were the same as those of Experiment 2, with the following two modifications. First, in all 24 target items and 36 filler items, the word order of B's first response sentence was SVO. Second, for all target items, there were two versions of B's first response sentence. In the *AUCH*-[NEGDR] version, it contained the additive focus particle *auch* ('too') to enforce the NEGDR resolution of the propositional anaphor. In the *ABER*-[POSDR] version, B's first response sentence contained the adversative adverb *aber* ('but') to enforce the POSDR resolution of the propositional anaphor. For the filler items, there was only one version of B's first response sentence. In 20 filler items, it either contained the particle *auch* ('too') or the adverb *aber* ('but'); in the remaining 26 filler items, it contained neither of the two expressions.

Design and Procedure Experiment 3 employed a 2x2 within-subject design with the factors INTERPRETATION MANIPULATION (*AUCH*-[NEGDR]/*ABER*-[POSDR]) and CONTINUATION TYPE (NEGDR CONSISTENT/POSDR CONSISTENT). The four conditions were counterbalanced across four participant groups and four sets of items (cf. Pollatsek and Well, 1995). The procedure was the same as in Experiment 2.

2.3.1. Results and discussion

The median ratings in the four conditions of Experiment 3 are shown in Table 5. The data were submitted to a cumulative link mixed model analysis with participants and items as random effects. The fixed factors were INTERPRETATION MANIPULATION and CONTINUATION TYPE with sum coding (+.5 for *AUCH*-[NEGDR] and NEGDR-CONSISTENT; -.5 for *ABER*-[POSDR] and POSDR-CONSISTENT). The analysis yielded no significant main effect of INTERPRETATION MANIPULATION (β = -.01, *SE* = .14, *z* = -.03, *p* = .98). There was a significant main effect of CONTINUATION TYPE (β = .93, *SE* = .14, *z* = 6.57, *p* < .001), which was qualified by a significant interaction between the two factors (β = 5.68, *SE* = .33, *z* = 17.37, *p* < .001). To examine the interaction, we conducted separate analyses for the data subsets of the two INTERPRETATION MANIPULATION conditions. In the *AUCH*-[NEGDR] data subset, the ratings were significantly higher in the NEGDR-CONSISTENT condition than in the POSDR-CONSISTENT condition (β = 4.19, *SE* = .30, *z* = 14.07, *p* < .001). In the *ABER*-[POSDR] data subset, the ratings were significantly higher in the POSDR-CONSISTENT condition than in the NEGDR-CONSISTENT condition (β = -1.79, *SE* = .20, *z* = -8.92, *p* < .001).

	INTERPRETATION MANIPULATION	
CONTINUATION TYPE	*AUCH*-[NEGDR]	*ABER*-[POSDR]
NEGDR CONSISTENT	5	2
POSDR CONSISTENT	1	5

Table 5: Median ratings in the four conditions of Experiment 3

The main finding of Experiment 3 is that the interpretation manipulation via *auch* (‘too’) vs. *aber* (‘but’) resulted in reverse acceptability-rating patterns. When a NEGDR-interpretation was enforced, the rating pattern was the same as the overall pattern of Experiment 2, with higher ratings in the NEGDR-consistent condition compared with the POSDR-consistent condition. This part of the results of Experiment 3 bolsters the conclusion that the rating pattern observed in Experiment 2 with ambiguous propositional anaphors reflects a strong preference for the NEGDR resolution. When a POSDR-interpretation was enforced, the ratings were higher in the POSDR-consistent version of the continuation sentence compared with the NEGDR-consistent version. This indicates that the rating pattern of Experiment 2 was not due to a general low acceptability of the POSDR-consistent version of the continuation sentences. As to the specific objective of Experiment 3, its findings do not corroborate the suspicion that the indirect method of Experiment 2 may not have been suitable to investigate resolution preferences for polarity-ambiguous propositional anaphors. Rather, the reverse result patterns for the two INTERPRETATION MANIPULATION conditions strengthen the notion that the ratings of the continuation sentences in Experiment 2 are indicative of the interpretation of the preceding ambiguous anaphor.

3. Conclusion

The goal of our experimental study was to explore how propositional anaphors that are polarity-ambiguous between a NEGDR interpretation and a POSDR interpretation are resolved. We considered three hypotheses, (1) a default preference for the NEGDR interpretation, under the assumption that the NEGDR is more salient than the POSDR; (2) a default preference for the POSDR interpretation, under the second, contrary assumption that the POSDR is more salient than the NEGDR; (3) no default preference, under the third assumption that the two propositional discourse referents do not differ in saliency.

In Experiment 1, we employed a 2AFC task, in which participants were asked to choose between a NEGDR-interpretation alternative and a PosDR-interpretation alternative. The results suggest a preference for the NEGDR interpretation of polarity-ambiguous propositional anaphors, which can be modulated by word order and possibly by verb type up to an equal distribution of NEGDR and POSDR interpretations with SVO word-order and belief verbs as predicate. One possible account of this finding is in terms of the no-default-preference hypothesis. According to this hypothesis, the two antecedent candidates, NEGDR and POSDR, do not differ in saliency. Consequently, other factors could take effect on the resolution of the ambiguous anaphor, such as characteristics of the linguistic material (e.g. word order and verb type). However, as was pointed out in the discussion of Experiment 1, the different results for the two verb types must be taken with a large grain of salt because the items in the two subsets differed not only in the predicate. Moreover, the modulating effect of word order could not be replicated in Experiment 2, in which we employed an indirect method to tap into the interpretation preferences of the participants.

In Experiment 2, the task of the participants was to rate the acceptability of a continuation sentence that was either consistent with the NEGDR resolution and inconsistent with the POSDR resolution of the polarity-ambiguous propositional anaphor in the preceding sentence or vice versa. The ratings were found to be affected solely by the type of the continuation sentence. The median of the ratings for the NEGDR-consistent continuation sentences corresponded to the highest level on the rating scale whereas the median of the rating for the POSDR-consistent continuation sentences corresponded to the lowest level, suggesting that the ambiguous anaphors in the preceding sentences were overwhelmingly resolved with the NEGDR. This conclusion was bolstered by the findings of Experiment 3.

In Experiment 3, we employed the same rating task as in Experiment 2. However, the interpretation of the polarity-ambiguous propositional anaphors was restricted by adding a constraining expression. The ratings were determined by an interaction of the interpretation restriction with the content of the continuation sentences. When the NEGDR-interpretation was enforced (via the additive particle *auch* ['too']), the rating pattern was the same as in Experiment 2. In contrast, when the POSDR-interpretation was enforced (via the adversative adverb *aber* ['but']), the ratings were significantly higher for POSDR-consistent continuation sentences compared with the NEGDR-consistent continuation sentences.[4] This pattern of results strongly suggests that the ratings of the continuation sentences are indicative of the resolution of the preceding ambiguous anaphor. Correspondingly, the method employed in Experiment 2 can be considered as suitable for uncovering resolution preferences.

[4] Note, that it is not the mere presence of the additive particle *auch* ('too') vs. adversative adverb *aber* ('but') which enforces the NEGDR- vs POSDR-resolution of polarity-ambiguous propositional anaphors. Rather, it is crucial which resolution alternative affords the additive vs. adversative function of the expressions. This is illustrated in (i) with negative versions of the sample item's response sentence, which show a pattern that is opposite to their positive counterparts: *Auch* enforces the POSDR-interpretation (see (iB)) and *aber* enforces the NEGDR-interpretation (see (iB')).

(i) A: Tom hat die Tasche nicht gestohlen. 'Tom didn't steal the bag.'
B: Jenny glaubt das$_{\mathrm{POSDR}}$ auch nicht. 'Jenny doesn't believe that$_{\mathrm{POSDR}}$ either.'
B': Aber Jenny glaubt das$_{\mathrm{NEGDR}}$ nicht. 'But Jenny doesn't believe that$_{\mathrm{NEGDR}}$.'

With regard to the mixed findings of Experiment 1 and Experiment 2, we propose that they can be reconciled by taking into consideration, differences in the experimental situation that are inherent to the different methods in the two experiments. The forced choice task that we employed in Experiment 1 involved a rather artificial setting, in which the ambiguity of the sentences containing the propositional anaphor and the two possible interpretations were made explicit. By contrast, the rating task of Experiment 2 did not draw participants' attention to the ambiguity of the propositional anaphor and its two possible interpretations. In this regard, the experimental situation in Experiment 2 constituted a somewhat more natural condition of language comprehension than that of Experiment 1. We assume that the rating data that we obtained in Experiment 2 reflect the spontaneous resolution of the polarity-ambiguous anaphors. That is, we act on the assumption of a strong default preference for the NEGDR resolution under unprompted conditions[5]. It is likely, that the particularities of the direct task in Experiment 1 induced a tendency to override the default NEGDR-preference. More specifically, the presentation of the two interpretation alternatives may have prompted the participants to consciously or unconsciously reassess their interpretation of the sentence containing the propositional anaphor. This may have enhanced their sensitivity to characteristics of the linguistic material (such as word order and predicate type), which, in turn, resulted in favouring one of the two presented interpretation alternatives over the other.

As was already mentioned, we conclude from the findings of Experiment 2, that there is a default preference to resolve a polarity-ambiguous propositional anaphor with the NEGDR. One may object that the findings do not reflect a true default, which is generally in effect. Rather, the preference for the NEGDR might be due to particular features of our items. It might have been crucial that the material consisted in dialogues and that the target anaphor was contained in a reply to an assertion of another speaker. There may be a bias to favour responses that can be considered to provide evidence for the interlocutor's assertion or that convey that the interlocutor's belief is shared by a third party over responses that can be considered to provide evidence against the interlocutor's assertion or that convey that a third party has an opposite belief, resulting in a pragmatically driven preference for the NEGDR interpretation of the response. Though this pragmatic-bias account does not rule out that there is a default preference for the NEGDR, it does cast doubt on the soundness of that conclusion: Taking the pragmatic bias for granted, it should not matter whether and which default preference there is. That is, when there actually is no default preference there should still be a preference for the NEGDR interpretation due to the pragmatic bias, and when there actually is a default preference for the POSDR then this may be overridden by the pragmatic bias. Yet, there are two reasons to doubt that the assumed pragmatic bias can fully account for the findings of Experiment 2. First, it seems reasonable to assume that the pragmatic bias is stronger for reporting verbs than for belief verbs (see the discussion of Experiment 1). Thus, the preference for the NEGDR interpretation in Experiment 2 should have been more pronounced for the items with reporting verbs. Second, if the resolution preference for the NEGDR was solely due to a pragmatic bias, then the content of a POSDR-consistent continuation should have acted as a cue to the intended meaning of the preceding sentence. Thus, the finding that the

[5] It remains to be seen whether this assumption can be experimentally supported with data from a genuine indirect method, e.g. reading-time or eye-tracking data. Based on the findings of Experiment 2, we expect shorter processing times and fewer regressions to the preceding context for the NEGDR-consistent continuations compared with the POSDR-consistent continuations.

POSDR-consistent continuation sentences overwhelmingly received low ratings is challenging for the pragmatic-bias account but it can be readily explained when assuming a default preference for the NEGDR due to its high saliency. However, it remains an empirical task to evaluate the validity and scope of the pragmatic-bias account.

More generally, future research is needed to disentangle default-preference effects from materials- or task induced effects. This necessitates the use of fine-grained online measures of anaphor processing, such as eye tracking and ERP data. A further relevant task for future research is to put the assumptions as to the relative saliencies of the NEGDR and the POSDR to a pure test by directly testing their accessibility with a plain measure, i.e. uncontaminated by concurrent task demands. However, this requires developing novel methodological approaches considering that established measures of accessibility that have been employed in studies on nominal discourse referents may be inapplicable to the investigation of the accessibility of propositional anaphors.

In conclusion, the present study explored the interpretation of polarity-ambiguous propositional anaphors, which has not been experimentally addressed before. The implications of our findings are two-fold. First, they (re)demonstrate the necessity of methodological variety in research on anaphor resolution. Second, they point to a preference for resolving polarity-ambiguous propositional anaphors with the NEGDR rather than with the POSDR, which may reflect a default preference stemming from a higher saliency of the NEGDR.

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Attributive adjectives in Tswefap: Vague predicates in a language with degrees[1]

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Abstract. This paper discusses the semantics of gradable verbs and adjectives in Tswefap (Narrow Grassfields; Cameroon), an 'exceed comparative' language. I use diagnostics proposed by Beck et al. (2009) to probe the semantic type of these gradable predicates. Interestingly, the diagnostics diverge for the two categories of gradable expressions. I argue that Tswefap gradable verbs have degree arguments, while gradable adjectives are vague ⟨e,t⟩ predicates. The fact that gradable predicates in Tswefap differ in semantic type systematically according to their syntactic category raises interesting questions for debates regarding the uniformity of the encoding of gradability across expressions of different categories. These facts suggest that even in a language with ⟨d,⟨e,t⟩⟩ predicates, gradability need not be encoded via degree arguments for all gradable expressions.

Keywords: gradability, comparison, degree semantics, Tswefap, semantic variation, semantic fieldwork, syntax/semantics interface, lexical categories.

1. Introduction

The crosslinguistic study of comparison and gradability has revealed a great deal of variation in the semantics of these expressions. One particularly fundamental way that languages have been argued to differ is in the semantic type of gradable expressions themselves. As a result of crosslinguistic comparative work, Beck et al. (2009) propose that languages can differ in whether their gradable predicates utilize degree arguments, arguments of type d. For languages that have a positive setting for the Degree Semantics Parameter (DSP), such as English, gradable predicates are of type ⟨d,⟨e,t⟩⟩ (abstracting away from potential event arguments for gradable verbs). For languages that have a negative setting for the parameter, gradable predicates are instead of type ⟨e,t⟩. Beck et al. (2009) argue that Motu (Austronesian; Papua New Guinea) is an example of a language that lacks degree arguments in this way. In subsequent work, other authors have argued that languages can indeed lack ⟨d,⟨e,t⟩⟩ predicates. For example, Bochnak (2015) argues that Washo (isolate; USA) gradable predicates are of type ⟨e,t⟩ and Deal and Hohaus (this volume) argue for a similar treatment of Nez Perce (Sahaptian; USA).

In this paper I argue upon the basis of novel data from Tswefap (Narrow Grassfields; Cameroon) that even within a single language there can be variation in whether basic lexical gradable predicates are of type ⟨d,⟨e,t⟩⟩ or simply of type ⟨e,t⟩. Specifically, using diagnostics developed by Beck et al. (2009), I argue that gradable verbs in Tswefap can best be analyzed as taking degree arguments while gradable adjectives are most straightforwardly analyzable as vague ⟨e,t⟩ predicates. Thus even if a language utilizes degree arguments for some gradable predicates, it may not make use of them for all gradable predicates. Additionally, it appears that, at least in

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Tswefap, this choice is made along the lines of syntactic categories. Therefore, the Tswefap patterns raise interesting questions for the crosslinguistic study of the encoding of gradability across syntactic categories, suggesting that gradability need not be encoded in the same way across all categories in a single language.

The structure of the paper is as follows. In Section 2 I introduce the distinction between gradable verbs and adjectives in Tswefap. I argue that gradable verbs show evidence for degree arguments and abstraction over degrees in Section 3. For gradable adjectives, on the other hand, I present data in Section 4 that demonstrate that the same diagnostics used for verbs do not yield similar results. Instead, the behavior of adjectives can be more simply accounted for if they are ⟨e,t⟩ predicates. In Section 5 I offer a comparison to Yoruba (Benue-Congo; Nigeria), a language which displays a similar pattern in terms of gradable verbs and adjectives (Beck et al., 2009; Howell, 2013). Finally, I offer concluding remarks in Section 6.

2. Gradable predicates of two syntactic categories

Property concept terms in Tswefap can syntactically be expressed as adjectives or verbs. There are often adjectives and verbs with similar meanings, but the adjectives are not clearly morphologically derived from the verbs, nor vice versa. Additionally, adjectives and verbs are not freely interchangeable. This is demonstrated with the adjective *mezhwe* 'small' and the verb *khoh* 'be small' in (1) and (2).[2]

(1) a. [**Mezhwe** mi] a tseuk nkumnkum.
small person FACT eat fufu
'The small person ate fufu.'

b. * [Mi yoh] a **mezhwe**.
person DEM FACT small
Intended: 'That person is small.'

(2) a. [Mi yoh] a **khoh**.
person DEM FACT be.small
'That person is small.'

b. * [**Khoh** mi] a tseuk nkumnkum.
be.small person FACT eat fufu
Intended: 'The small person ate fufu.'

In (1a), we see that adjective *mezhwe* can appear as an attributive adjective within the noun phrase. In (2a), we see that the verb *khoh* can appear as the main predicate of the sentence, occurring with factative aspect marker *a* just like the verb *tseuk* 'eat' in (1a). In (1b), we see that it is ungrammatical to use the adjective *mezhwe* as the predicate. Likewise, it is ungrammatical to use the verb *khoh* as an attributive adjective, as demonstrated in (2b). Note, too, that the two property concept terms, despite having similar meanings, are not morphophonologically related in a straightforward way.

[2] I use the following glossing conventions throughout: 3 = third person, ASP = aspect, CNS = consecutive verb marker, DEM = demonstrative, FACT = factative aspect, INF = infinitive, LNK = linker, NEG = negation, Q = quantifier, SG = singular, STD = standard.

There is a relatively small set of adjectives in Tswefap that have the distribution of *mezhwe* in (1a). These include terms related to size, such as *sesege* 'tall' and *mbu'* 'big', and color, like *sese* 'black' and *fefe* 'white'. Gradable verbs are more common and there are some gradable verbs (such as *zhi* 'be rich') which do not appear to correspond to an adjective with a similar meaning. In contrast, there seem to be no gradable adjectives which lack a corresponding verb. The focus of the remainder of the paper will be on the semantic types of these two classes of predicates.

3. Gradable verbs and degree arguments

As mentioned in the introduction, Beck et al. (2009) propose that languages can differ in whether their gradable predicates take degree arguments. This is their Degree Semantics Parameter (DSP), given in (3).

(3) Degree Semantics Parameter (DSP):
A language {does/does not} have gradable predicates (type $\langle d,\langle e,t\rangle\rangle$ and related), i.e. lexical items that introduce degree arguments. (Beck et al., 2009: 19)

They also propose that languages with a positive setting for the DSP can differ in whether or not they allow abstraction over degree arguments. This is their Degree Abstraction Parameter (DAP), given in (4).[3]

(4) Degree Abstraction Parameter (DAP):
A language {does/does not} have binding of degree variables in the syntax.
(Beck et al., 2009: 14)

They propose several diagnostics for distinguishing whether a language has a positive or negative setting for these parameters. In this section, I will discuss these diagnostics as they apply to gradable verbs in Tswefap. I will demonstrate that based upon evidence from all of the diagnostics, Tswefap can be analyzed as having a positive setting for both the DSP and DAP. Its gradable verbs take degree arguments, and the language allows abstraction over variables of type d. In order to understand the data related to these diagnostics, I will first provide a brief overview of the structure of comparatives in Tswefap, since the comparative figures in several of the constructions used to diagnose the parameter settings.

3.1. The structure of Tswefap comparatives

Tswefap utilizes an 'exceed comparative' in the typology of Stassen (1985). This means that the comparative morpheme is a verb, meaning something like 'exceed' or 'pass'. In Tswefap, the comparative morpheme is the verb *tchege*, which can also be used in non-comparative contexts to simply mean 'pass' or 'overtake'. In comparatives, *tchege* typically appears as the final verb in a serial verb construction. The most common strategy for forming a comparative is for the gradable predicate to appear as the first verb in the serial verb construction, followed by the comparative verb *tchege*. *Tchege* is a transitive verb, and the standard of comparison is introduced as its object. This strategy is illustrated in (5) and (6). I will refer to this as

[3] Note that this parameter was originally proposed by Beck et al. (2004).

the simple comparative. Note that, as is typical for serial verb constructions, tense and aspect information is indicated once at the beginning of the string of verbs. All non-initial verbs in a serial verb construction (including *tchege*) surface with the consecutive marker *n-*.

(5) Nkwehnwoh a seh n-tchege Chimi.
Kuamo FACT be.tall CNS-pass Chimi
'Kuamo is taller than Chimi.'

(6) Chimi a voh n-tchege Nkwehnwoh.
Chimi FACT be.short CNS-pass Kuamo
'Chimi is shorter than Kuamo.'

In (5), we see that the gradable verb *seh* 'be tall' appears as the first verb in the serial verb construction, while *tchege* follows it. In (6), the gradable verb *voh* 'be short' is now the initial verb in the serial verb construction. This demonstrates that both the "positive" and "negative" members of pairs like *tall/short* can be used in this type of comparative construction (see Seuren, 1978; Kennedy, 1997; Sánchez Valencia, 1998, a.o., for a discussion of polarity in gradable predicates).

In addition to this comparative construction, Twsefap also allows a comparative to be formed with the verb *loh* 'take' and the comparative verb *tchege*. In this construction, the object of the transitive verb *loh* is an infinitival form of the gradable verb. This construction is illustrated in (7) and (8), once again shown with positive and negative members of an antonymous pair of gradable verbs. I will refer to this construction as the *loh* comparative.

(7) Chimi a loh mbege seh n-tchege Nkwehnwoh.
Chimi FACT take INF be.tall CNS-pass Kuamo
'Chimi is taller than Kuamo.'

(8) Chimi a loh mbege voh n-tchege Nkwehnwoh.
Chimi FACT take INF be.short CNS-pass Kuamo
'Chimi is shorter than Kuamo.'

In (7), we see the verb *loh*, which takes as its object the gradable predicate *seh* 'be tall' (which occurs with the infinitival marker *mbege*). The second verb in the serial verb construction is once again the comparative morpheme *tchege*. In (8), we see the same construction, but with *voh* 'be short' as the gradable predicate.

With both of these syntactic strategies for the expression of the comparative it is possible to include a measure phrase differential. The measure phrase can be introduced in a PP that occurs after the standard of comparison, as seen in (9) for the simple comparative and (10) with the *loh* comparative. With the simple comparative it is also possible for the measure phrase PP to intervene between the gradable predicate and the comparative verb *tchege*, as demonstrated in (11).

(9) Nkwehnwoh a seh n-tchege Chimi **pu ta’ tswe**.
Kuamo FACT be.tall CNS-pass Chimi with one head
‘Kuamo is one head taller than Chimi.’

(10) Chimi a loh mbege seh n-tchege Nkwehnwoh **pu ta’ tswe**.
Chimi FACT take INF be.tall CNS-pass Kuamo with one head
‘Chimi is one head taller than Kuamo.’

(11) Chimi a seh **pu ta’ tswe** n-tchege Nkwehnwoh.
Chimi FACT be.tall with one head CNS-pass Kuamo
‘Chimi is one head taller than Kuamo.’

In (9) the gradable verb *seh* ‘be tall’ and the comparative verb *tchege* form a serial verb construction. The measure phrase differential *ta’ tswe* ‘one head’ is introduced by the preposition *pu* ‘with’ after the standard of comparison. In (10), the infinitival form of the gradable verb *seh* ‘be tall’ is the object of the verb *loh* ‘take’, which forms a serial verb construction with the comparative verb *tchege*. Once again, the measure phrase *ta’ tswe* ‘one head’ is introduced in a PP after the standard of comparison. Finally, in (11), we see another instance of a serial verb construction involving the gradable verb *seh* ‘be tall’ and the comparative *tchege*, but the measure phrase PP *pu ta’ tswe* ‘with one head’ now appears between the two verbs.

Finally, it is worth noting that, because comparatives are formed with serial verb constructions, there is not a limit of two verbs. This results in another strategy for the inclusion of a measure phrase differential. The first verb of the serial verb construction can be *loh* ‘take’ and the measure phrase can occur as the object of this verb. The gradable verb and the comparative verb *tchege* can then appear as the second and third verbs in the serial verb construction. This construction is illustrated in (12).

(12) Chimi a loh ta’ tswe seh n-tchege Nkwehnwoh.
Chimi FACT take one head be.tall CNS-pass Kuamo
‘Chimi is one head taller than Kuamo.’

Here the transitive verb *loh* takes as its object the measure phrase *ta’ tswe* ‘one head’. The second verb in the serial verb construction is the gradable verb *seh* ‘be tall’.[4] The third and final verb is the comparative verb *tchege*.[5]

[4]Typically all non-initial verbs in a serial verb construction appear with the consecutive marker *n-*. However, due to phonotactic constraints, this prefix cannot surface before *seh* because of the initial [s].

[5]It is also possible to use a measure phrase differential with the comparative verb *tchege* to express a comparative even without the use of an overt gradable predicate. Instead, the measure phrase serves to indicate the scale of comparison. There are two constructions where this is possible. The first involves a serial verb construction with *loh* and *tchege*, as seen previously. Here, the measure phrase occurs as the object of *loh*, as in (i) and (ii).

(i) Chimi a loh ta’ tswe n-tchege Nkwehnwoh.
Chimi FACT take one head CNS-pass Kuamo
‘Chimi is one head taller than Kuamo.’

3.2. Evidence for degree arguments

With this understanding of the morphosyntax of comparatives in Tswefap, we turn to a discussion of the diagnostics used to identify whether the gradable predicates of a given language take degree arguments. Beck et al. (2009) identify two such diagnostics. The first involves the availability of measure phrase differentials. As was demonstrated in examples (9)-(12) above, Tswefap does allow measure phrase differentials to occur in comparative constructions with gradable verbs. The second diagnostic proposed by Beck et al. (2009) is the acceptability of comparison with a degree. If a language allows a degree-denoting expression to be the standard of comparison, this is evidence that its gradable predicates take type d arguments. We see in (13) that comparison with a degree is possible in Tswefap.

(13) Chimi a seh n-tchege ta' meyteh.
Chimi FACT be.tall CNS-pass one meter
'Chimi is taller than one meter.'

In (13) we see a simple comparative involving the gradable verb *seh* 'be tall'. Here, the standard of comparison that appears after *tchege* does not denote an individual, as has been seen in the previous examples. Instead, it is the degree-denoting expression *ta' meyteh* 'one meter'.

The evidence from measure phrase differentials and comparison with a degree suggests that Tswefap has a positive setting for the DSP; its gradable verbs have degree arguments. The positive setting for this parameter aligns Tswefap with other languages that utilize similar exceed comparatives, such as Luganda (Bantu; Uganda; Bochnak, 2018), Mooré (Gur; Burkina Faso; Beck et al., 2009), and Yoruba (Beck et al., 2009; Howell, 2013).

(ii) Chimi a loh ngu' toh n-tchege Nkwehnwoh.
Chimi FACT take year five CNS-pass Kuamo
'Chimi is five years older than Kuamo.'

In (i), the measure phrase *ta' tswe* 'one head' appears as the object of *loh*. It indicates that the scale of comparison is height. Interestingly, while the exceed comparative can be used for both a 'taller' and 'shorter' meaning with an overt gradable predicate, without a gradable predicate only the positive meaning (i.e. 'taller') is possible. In (ii), the verb *loh* takes as its object the measure phrase *ngu' toh* 'five years', indicating that the scale of comparison is age.

The second comparative construction that lacks an overt gradable predicate involves only the verb *tchege* and a measure phrase introduced in a PP. This construction is illustrated in (iii) and (iv).

(iii) Chimi a tchege Nkwehnwoh pu ta' meyteh.
Chimi FACT pass Kuamo with one meter
'Chimi is one meter taller than Kuamo.'

(iv) Chimi a tchege Nkwehnwoh pu ngu' toh.
Chimi FACT pass Kuamo with year five
'Chimi is five years older than Kuamo.'

In (iii), the comparative verb *tchege* is the only verb of the sentence. The measure phrase *ta' meyteh* 'one meter' is introduced by the preposition *pu* 'with' after the standard of comparison. As with the previous construction lacking a gradable verb, the scale of comparison, here height, is identified by the measure phrase. In (iv) we see the same construction with the measure phrase *ngu' toh* five years, indicating a comparison of age.

3.3. Evidence for degree abstraction

Now that we have seen evidence that Tswefap gradable verbs do, in fact, take degree arguments, it is useful to consider whether the language allows abstraction over degrees. This is the DAP of Beck et al. (2009). Assuming a semantics of comparison based on Heim (2000), Beck et al. provide five diagnostic tests for determining whether degree abstraction is possible in a language. These are the availability of direct measure phrases, degree questions, and subcomparatives, as well as the presence of scope ambiguities and negative island effects for degree phrases.

The first diagnostic for degree abstraction that I will consider is the availability of direct measure phrases. Tswefap does allow measure phrases to combine directly with some gradable verbs, as demonstrated in (14) with *tsey* 'be heavy'.[6]

(14) Chimi a tsey kilo ghap.
Chimi FACT be.heavy kilo ten
'Chimi weighs ten kilos.' (*Literally:* 'Chimi is ten kilos heavy.')

In (14) we see that *tsey* combines directly with the measure phrase *kilo ghap* 'ten kilos'. Under the analysis given by Beck et al. (2009), this is possible because the measure phrase moves to form an abstraction over degrees, as illustrated in (15).

(15) [[ten kilos] [1 [Chimi is t_1 heavy]]]

The second diagnostic for degree abstraction is degree questions. Degree questions are possible in Tswefap, as seen in (16).

(16) Chimi a seh ndohk pa'lieh?
Chimi FACT be.tall Q how
'How tall is Chimi?'

Under the analysis given by Beck et al. (2009), degree questions involve a quantificational element that moves to create an abstraction over degrees. The resulting meaning can be paraphrased roughly as 'For which d is Chimi d-tall?'.

The third piece of evidence for degree abstraction in Tswefap comes from the availability of subcomparatives, as shown in (17).[7]

(17) Chimi a seh n-tchege pa' nkhe Nkwehnwoh ne seh a.
Chimi FACT be.tall CNS-pass like rope Kuamo INF be.long like
'Chimi is taller than Kuamo's rope is long.'

[6] Schwarzschild (2005) notes that there is considerable variation crosslinguistically in which gradable predicates can combine with measure phrases directly. So while English *heavy* cannot combine directly with a measure phrase, German *schwer* (and Tswefap *tsey*) can.
[7] Note that Tswefap *seh* is used both to mean 'be tall' and 'be long'.

Here the maximal degree of Chimi's height is being compared to the maximal degree of length of Kuamo's rope. Because what must be compared here is two sets of degrees, this requires abstraction over degrees.

A fourth diagnostic used by Beck et al. (2009) to diagnose degree abstraction derives from work by Heim (2000). Heim argues that if a degree expression (DegP) acts as a quantifier, it should be able to show scope interactions with other quantificational elements in a sentence. Specifically she examines the scope interactions of modals and DegPs, arguing that DegPs in English do, in fact, show the type of scope ambiguity expected if they are able to move to a position above a modal. Beck et al. (2009) therefore assume that if a language shows English-style scope ambiguities with degree expressions this indicates that the DegP is able to undergo movement to create an abstraction over degrees. In Tswefap, we do see the type of scope ambiguity that is discussed by Heim (2000). This is shown by the example in (18).

(18) Yi me ntchohk nge pa' yoh loh kwa' sehntimeyteh yeh pege seh
it.is.required that building DEM take exactly centimeter LNK two be.tall
n-tchege pa' yi ne mbi ndeh le.
CNS-pass like 3SG INF be now like
'It is required that the building be exactly two centimeters taller than it is now.'
✓ Context 1: $\forall w > max$
You are in a contest where you have to build a model building out of clay. The building must be 3 meters tall, no more, no less. Currently, your building is 2.98 meters tall. Can the judge say the following truthfully?
?✓ Context 2: $max > \forall w$
You are in a contest where you have to build a model building out of clay. The building must be at least 3 meters tall, but can be more. Currently, your building is 2.98 meters tall. Can the judge say the following truthfully?

In (18), we see that this Tswefap utterance is ambiguous between two readings. The first reading corresponds to the surface scope of the modal and the DegP, with the modal scoping above the DegP. This reading is true in a context where the building must be exactly two centimeters taller than its current height and is not allowed to be any taller than that according to the rules. The second reading reflects the inverse scope where the DegP has covertly moved above the modal and takes widest scope.[8] This reading is true in a context where the building must be at least two centimeters taller than its current height but is allowed to be taller than that. The availability of both readings in Tswefap indicates that DegPs must be able to undergo movement and create abstractions over degrees.

The final diagnostic used by Beck et al. (2009) to diagnose abstraction over degrees is the presence of negative island effects. In languages like English, negation in the standard of comparison results in unacceptability, as in (19).

(19) * Chimi bought a more expensive book than no one did.

[8]Note that this reading is judged as possible, but not as natural as the reading involving surface scope. That is, the surface scope reading is preferred but is not the only available interpretation.

However, in a language like Japanese, which has been argued to involve comparison of individuals rather than degrees, such unacceptability does not arise (Beck et al., 2004). It has been argued by von Stechow (1984) that this unacceptability in English arises from the fact that the English *than*-clause involves abstraction over degrees and the maximal degree such that no one bought a d-expensive book is undefined. There is no maximum, and therefore this cannot serve as the standard of comparison. Rullmann (1995) observes that this same type of negative island effect is found in degree questions in English. If negation is present in a degree question, the result is ungrammaticality, as in (20).

(20) * How tall isn't Chimi?

Here, as in comparatives with negation in the standard of comparison, the maximal degree such that Chimi is not d-tall is undefined, yielding unacceptability. Turning to Tswefap, we find that, like in English, negation in degree questions results in a negative island effect. This is shown in (21).[9]

(21) * Chimi ka seh ndohk pa'lieh?
Chimi NEG.FACT be.tall Q how
Intended: 'How tall isn't Chimi?'

The unacceptability of (21) demonstrates that degree questions do indeed involve abstraction over degrees. Furthermore, negation yields unacceptability due to the fact that the maximum is undefined. Thus, this negative island effect provides another piece of evidence in favor of degree abstraction.

All five of the diagnostics proposed by Beck et al. (2009) for diagnosing the setting of the DAP yield the same result for Tswefap gradable verbs. Not only do Tswefap gradable verbs have degree arguments, but it is also possible for degree quantifiers to create abstractions over degrees in the language. This means that Tswefap has positive parameter settings for Beck et al.'s DSP and DAP.

4. Gradable adjectives as ⟨e,t⟩ predicates

In the previous section, I discussed the evidence for treating gradable verbs in Tswefap as having degree arguments, on a par with gradable adjectives in languages like English. Additionally, I provided further evidence that gradable verbs in Tswefap take degree arguments and can combine with a class of quantificational degree operators by demonstrating that degree abstraction is possible in Tswefap. In this section, however, I will show that gradable adjectives in Tswefap

[9] I was unable to elicit a suitable construction that would allow for the testing of negative island effects in the standard of comparison in Tswefap. The closest construction provided by my consultant involved a relative clause rather than negation in a clausal comparative. This construction is shown in (v).

(v) Chimi a yu ta' nwa'nye me yeh teuk n-tchege yoh yi sop mi nteh yu a.
Chimi FACT buy one book that it be.expensive CNS-pass DEM REL no person NEG buy REL
'Chimi bought a more expensive book than the one no one bought.'

So long as the sentence in (v) is uttered in a context where there is a unique book that no one bought, it is acceptable, just like its English counterpart involving a relative clause.

behave quite differently from gradable verbs. Unlike verbs, these adjectives do not show evidence for taking degree arguments and cannot appear in the type of degree constructions that gradable verbs can appear in. I will argue that the simplest analysis of these facts involves the assumption that adjectives do not take degree arguments in Tswefap.

One of the first distributional facts to note about Tswefap attributive adjectives is that they cannot combine with the comparative morpheme *tchege*. (Recall that Tswefap does not allow adjectives to occur in predicative position.) Thus there is no way to form a comparative or superlative form of an attributive adjective, as demonstrated in (22).

(22) * [**Sesege** (n-)tchege (mbeh wohloh)] mi a tseuk nkumnkum.
tall CNS-pass everyone person FACT eat fufu
Intended: 'The taller/tallest person ate fufu.'

In (22), we see that it is ungrammatical for the comparative morpheme *tchege* to appear with the attributive adjective *sesege* 'tall', regardless of whether it surfaces with the consecutive marker *n-*. One concern might be that the comparative morpheme is a transitive verb and therefore must occur with an object (typically the standard of comparison). However, this construction remains ungrammatical even if it is combined with an overt standard of comparison, such as *mbeh wohloh* 'everyone'. This is the standard of comparison that is used to form a superlative in constructions with gradable verbs, as in (23), but it cannot be used with an attributive adjective.

(23) Chimi a seh n-tchege mbeh wohloh.
Chimi FACT be.tall CNS-pass everyone
'Chimi is the tallest.' (*Literally:* 'Chimi is taller than everyone.')

In order to form a comparative or superlative within the DP, a relative clause must be used instead of an adjective in an attributive position. In the relative clause, a gradable verb is used instead of a gradable adjective, as demonstrated by (24).

(24) Mi [yi **seh** n-tchege mbeh wohloh a] a tseuk nkumnkum.
person REL be.tall CNS-pass everyone REL FACT eat fufu
'The person that is taller than everyone ate fufu.'

Here in (24) we see a relative clause *yi seh ntchege mbeh wohloh a* 'that is taller than everyone' (or alternatively 'that is tallest'). Importantly, this relative clause contains the gradable verb *seh* 'be tall' and not the gradable adjective *sesege* 'tall'. Thus, in order to use the comparative morpheme *tchege*, a verb must be used as the gradable predicate.

The unavailability of the comparative morpheme with attributive adjectives makes it difficult to test other potential degree constructions such as difference comparatives. However, one degree expression that does not involve the comparative morpheme is a direct measure phrase. Unlike gradable verbs in Tswefap, gradable adjectives cannot combine directly with a measure phrase, as demonstrated in (25).

(25) * [**Sesege** meyteh pege] mi a tseuk nkumnkum.
tall meter two person FACT eat fufu
Intended: 'The two meter tall person ate fufu.'

Here we see that the measure phrase *meyteh pege* 'two meters' cannot combine with the adjective *sesege* 'tall'. Once again, as with the comparative, the strategy used to include a measure phrase within the DP involves a relative clause with a gradable verb. This construction is shown in (26).

(26) Mi [yi **seh** meyteh pege a] le tseuk nkumnkum.
person REL be.tall meter two REL ASP eat fufu
'The person that is two meters tall ate fufu.'

In this example, it is crucial that the gradable predicate in the relative clause is the verb *seh* 'be tall' and not an adjective. Thus, once again, there is no evidence that adjectives can combine with degree operators.

Interestingly, no other potential degree operators can occur with attributive adjectives in Tswefap. For example the degree modifier *tey* 'very' can appear with gradable verbs, as in (27). This degree modifier is ungrammatical with adjectives, as seen in (28), nor is there any equivalent modifier that can be used with an adjective.

(27) Chimi a **seh** tey.
Chimi FACT be.tall very
'Chimi is very tall.'

(28) Chimi a yoh ta' **sesege** (*tey) mbaga.
Chimi FACT see one tall very man
'Chimi saw a (*very) tall man.'

Therefore, from all of the available evidence with attributive adjectives it appears that these predicates do not show the same behavior as gradable verbs. Attributive adjectives cannot appear in any construction that would provide evidence that they take a degree argument.

Bochnak (2015) discusses a similar situation in Washo. Gradable predicates in Washo cannot occur in any environment that would require them to be analyzed as being $\langle d,\langle e,t\rangle\rangle$ predicates. Therefore, in the absence of any evidence that gradable predicates in the language require degree arguments, Bochnak argues that the most parsimonious solution is to assume that the predicates do not take degree arguments and are, in fact, of type $\langle e,t\rangle$. Following this same line of reasoning for Tswefap, the simplest analysis of attributive adjectives is to treat them as vague $\langle e,t\rangle$ predicates. Interestingly, unlike in Washo (or in Motu; Beck et al., 2009), there is evidence that some gradable predicates in Tswefap do take degree arguments, as discussed in Section 3. However, these gradable predicates are all syntactically verbs. Therefore, there is a split along the lines of syntactic categories in whether gradable predicates do or do not take degree arguments.

An alternative account of the behavior of Tswefap adjectives with respect to degree constructions would be to assume that adjectives are of type ⟨d,⟨e,t⟩⟩, but that there are syntactic restrictions that result in the unavailability of all overt degree morphology with adjectives. In order to treat adjectives as ⟨d,⟨e,t⟩⟩ we would have to assume that they obligatorily combine with a silent *pos* morpheme à la Cresswell (1976). In languages like English, a *pos* morpheme has been proposed to explain the availability of positive form adjectives with no overt element to saturate or bind the degree argument. In Tswefap, however, we would have to say that the use of *pos* is the only possible strategy for saturating or binding the degree argument of adjectives, unlike verbs. This is not an attractive stipulation. Similarly, it would seem stipulative to propose various disjoint syntactic requirements needed to rule out all degree morphology with adjectives in order to maintain this syntactic account. In the next section, I will provide a comparison of the Tswefap facts with data from Yoruba, for which a syntactic account of a similar pattern has been entertained. I will demonstrate that while the evidence in Yoruba is inconclusive, the Tswefap patterns provide stronger evidence in favor of a semantic treatment in terms of a type difference.

5. Comparison with Yoruba

Yoruba provides an interesting point of comparison to Tswefap in terms of the question of how gradability is encoded across different syntactic categories. It is particularly informative because the morphosyntax of comparison and gradable predicates is very similar. Yoruba gradable predicates can be expressed as either adjectives or verbs, like in Tswefap, and comparison in the verbal domain is similarly accomplished via an exceed comparative. Additionally, Yoruba has been discussed in detail regarding the question of the semantic type of gradable predicates and the settings for the degree parameters proposed by Beck et al. (2009). The discussion in this section will be largely based on the discussion of Yoruba in Beck et al. (2009) and subsequent work by Howell (2013).[10]

Beck et al. (2009) discuss gradable verbs in Yoruba and argue that they provide evidence for a positive parameter setting of the DSP. The two pieces of evidence that Beck et al. cite in favor of this conclusion are the availability of measure phrase differentials in comparatives, as seen in (29), and the acceptability of comparison with a degree, as in (30).

(29) Kathy fi esebata kan ga ju Sandra lo.
Kathy with foot one be.tall exceed Sandra STD
'Kathy is one foot taller than Sandra.' (Beck et al., 2009: 21)

(30) Kathy ga ju esebata marun ataabo lo.
Kathy be.tall exceed foot five and half STD
'Kathy is taller than five and a half feet.' (Beck et al., 2009: 21)

In (29) we see an exceed comparative, like in Tswefap, and the measure phrase PP *fi esebata kan* 'with one foot' is used as a differential. In (30), the standard of comparison is the degree phrase *esebata marun ataabo* 'five and a half feet'. These data are parallel to Tswefap examples (11) and (13), respectively.

[10] I have standardized the glossing conventions used in each source to more closely match the conventions used by Howell (2013).

The availability of degree abstraction in Yoruba has been a subject of debate in the literature. Beck et al. (2009) posit a negative setting for the DAP in Yoruba based on negative results for the five diagnostics discussed in Section 3.3. Howell (2013), however, argues for a positive setting for this parameter based on additional data from Yoruba. She confirms Beck et al.'s earlier findings regarding the absence of direct measure phrases and scope ambiguities.[11] She argues that degree abstraction can indeed be diagnosed via the remaining three diagnostics in Yoruba: degree questions, subcomparatives, and negative island effects. Howell argues that degree abstraction is involved in Yoruba degree questions, which are built using the equative verb, as shown in (31).

(31) Bawo ni Ade ṣe ga to?
how FOC Ade Q be.tall reach
'How tall is Ade?' (Howell, 2013: 281)

She also demonstrates that degree relatives in Yoruba can be used to form subcomparatives, as seen in (32).

(32) Michael Jordan je agbaboolu-alapere ti o dara ju bi David
Michael Jordan be basketball.player REL 3SG be.good exceed how David
Beckham ṣe je agbaboolu-elese lo.
Beckham Q be football.player STD
'Michael Jordan is a better basketball player than David Beckham is a (good) football player.' (Howell, 2013: 283)

Finally, she demonstrates that degree relatives display negative island effects, as shown by the unacceptability of (33).

(33) * John ra iwe to won ju bi Peter ko ṣe ra iwe ti o
John buy book REL expensive exceed how Peter not Q buy book REL 3SG
won.
expensive
'John bought a more expensive book than Peter didn't buy.' (Howell, 2013: 283)

This evidence from degree questions, subcomparatives, and negative islands would suggest that Yoruba is like Tswefap in the verbal domain, showing evidence for degree arguments and abstraction.

Howell (2013) notes that, in addition to gradable verbs, Yoruba also has gradable adjectives. Like in Tswefap, these two types of gradable predicates are not syntactically interchangeable.

[11] With respect to scope ambiguities, Howell (2013) suggests that their absence in Yoruba is not due to the inability of DegPs to move above other scope-taking elements. Instead she suggests that the lack of scope ambiguities is due to the fact that Yoruba lacks true modified numeral measure phrases such as 'exactly two centimeters'. She predicts that in a language with a similar morphosyntax for comparison and similar semantics for gradable verbs and comparison the presence of modified numeral measure phrases should allow for scope ambiguities. This prediction is borne out in Tswefap, which has an exceed comparative, degreeful gradable verbs, and modified numeral measure phrases such as *kwa' sehntimeyteh yeh pege* 'exactly two centimeters', and which does show scope ambiguities.

However, unlike in Tswefap, the adjectives are systematically morphologically derived from the verbs. This is done through reduplication of the first syllable (i.e. *sanra* ‘be fat’ vs. *sisanra* ‘fat’; Howell, 2013: 277). Howell notes that Yoruba adjectives cannot be used with the comparative morpheme, as seen in (34).

(34) * Ade je ọmọ sisanra ju bab re lọ.
Ade be child fat exceed father his STD
Intended: ‘Ade is a fatter child than his father.’ (Howell, 2013: 277)

In this respect, Yoruba is like Tswefap. Howell (2013) notes that this restriction could be semantic or syntactic in nature. She suggests that a semantic solution would be to assume that Yoruba adjectives are vague ⟨e,t⟩ predicates, in line with the hypothesis I have outlined for Tswefap. Alternatively, she suggests that a syntactic solution may involve assuming that the comparative morpheme in Yoruba subcategorizes for a verb and thus cannot be used with an adjective. She sets aside this question regarding adjectives since both hypotheses are compatible with the unavailability of the comparative with adjectives. Unfortunately, Yoruba does not allow direct measure phrases even with gradable verbs, so these expressions cannot be used to test whether adjectives could combine with a degree operator with a different syntax. Further, Howell does not discuss whether other types of degree modifiers (e.g. intensifiers such as ‘very’) can combine with adjectives.

In Tswefap, as already noted, the situation contrasts with what we see in Yoruba. We do find direct measure phrases with gradable verbs, but they cannot combine with adjectives. Additionally, degree modifiers like *tey* ‘very’ are entirely ruled out with adjectives. Because no construction that would provide evidence for degree arguments with Tswefap adjectives is grammatical, the evidence in favor of a semantic solution is stronger. For each type of degree operator we would have to posit a separate syntactic restriction to account for its unacceptability with adjectives. In contrast, if we simply assume that the semantic type of adjectives in Tswefap is ⟨e,t⟩ instead of ⟨d,⟨e,t⟩⟩ then all of the ungrammatical constructions are straightforwardly ruled out. Furthermore, there is no need to posit a silent *pos* morpheme to co-occur with every instance of a gradable adjective in Tswefap. Therefore, I conclude that based upon the range of evidence found in Tswefap, the most parsimonious account of the different distributions of adjectives and verbs in degree constructions is to posit a difference in semantic type between the two categories of predicates.

6. Conclusion

In this paper I have argued for a type distinction between gradable verbs and gradable adjectives in Tswefap. Based on the diagnostics proposed by Beck et al. (2009), I have demonstrated that Tswefap gradable verbs have degree arguments. In contrast, given the unacceptability of all degree morphology with gradable adjectives, I have argued that these are best treated as vague ⟨e,t⟩ predicates in Tswefap. This means that there is a divide along the lines of syntactic categories in Tswefap in terms of the semantic type of gradable predicates. Therefore, even in a language that has predicates that take degree arguments and that allows abstraction over degrees, it is still possible for some gradable predicates to be of type ⟨e,t⟩.

This more general conclusion that gradability may be encoded differently across different syntactic categories has interesting implications for the study of gradability crosslinguistically and especially for questions regarding gradable predicates that are not adjectives, such as gradable verbs and nouns. For languages such as English, which has $\langle d,\langle e,t\rangle\rangle$ adjectives, there has been debate about whether all gradable categories in the language must also utilize degree arguments (see e.g. Doetjes, 2008). Tswefap suggests that this need not be the case. Furthermore, the data from Tswefap are particularly interesting for this debate because it is adjectives which do not show evidence for taking degree arguments. This suggest that adjectives have no privileged status with respect to encoding gradability via degree arguments even in a language that does make use of $\langle d,\langle e,t\rangle\rangle$ predicates.

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Modeling "non-literal" social meaning[1]

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Abstract

Truth-conditional and socially indexical meanings have traditionally been studied in separate subfields. However, recent years have seen promising attempts to unify the semantics and pragmatics of the two (e.g. Smith et al., 2010; Acton and Potts, 2014). In particular, Burnett (2017, 2019) introduces a formalization of social meaning in terms of the Rational Speech Act (RSA) paradigm (Goodman and Frank, 2016). Building on this work, we address a central observation of contemporary sociolinguistics, that a linguistic variant may be used to index only *some aspects* of a speaker's identity. For instance, an adult can use childlike language features to convey not that they are a child (first order indexicality), but that they have certain traits associated with children, like cuteness or innocence (second order indexicality). Similarly, Eckert (2008) notes that some suburban Detroit teenagers use phonetic and syntactic forms conventionally associated with urban Detroit (such as vowel backing and negative concord), and hypothesizes that this is not to signal urbanity (i.e., *I am from urban Detroit*) per se, but rather to affiliate with certain perceived aspects of urbanity, such as being "autonomous, tough, and street-smart".

We model such uses of indexes with the mechanism of *projection functions* (Kao et al., 2014), to allow for utterances which are informative only along particular dimensions of meaning.

Keywords: Bayesian models, pragmatics, sociolinguistics, metaphor, higher order indexes.

1. Introduction

While truth-conditional semantics is concerned with the relation between linguistic utterances and the state of the world, a central concern of sociolinguistics is the relation between often truth conditionally equivalent *variants* and the identity of the *speaker* that these variants *index*.

Early sociolinguistics studies, such as Labov (1968), study the relation between membership in particular social categories (e.g. class, gender) and truth-conditionally equivalent phonetic variants (e.g. presence or absence of th-stopping). In more contemporary work, often referred to as *third wave sociolinguistics* (see (Eckert, 2012)), focus has turned to finer-grained notions of social identity, indexed by the use of correlated linguistic features, which make up *styles*. For instance, Pratt and D'Onofrio (2017) studies how the use of phonetic features such as creaky voice, in tandem with paralinguistic choices like jaw-setting are used to index a socially constructed valley girl *persona*, or social identity. As D'Onofrio (2016) puts it,

"This approach treats variation as a semiotic system (Eckert, 2008), in which linguistic features are viewed not as passive markers of speaker age, gender, or region, but as resources that speakers use toward any number of social or interactional ends."

[1]We would like to thank Judith Degen for her very helpful guidance in the early stages of this project, as well as the rest of the Stanford linguistics department.

Probabilistic Perspective Following Burnett (2017, 2019), we argue both here and in (Qing and Cohn-Gordon, in press) for the appropriateness of Bayesian inference as a tool to model aspects of sociolinguistic theory, particularly from the third wave perspective.

Concretely, let $\mathbf{u} \in U$ be a style, represented as an n-tuple $(u_1 ... u_n)$ where each u_i is a linguistic feature in a speaker's production. Similarly, let an identity $\mathbf{w} \in W$ be an n-tuple of socially relevant variables $(w_1 ... w_n)$. For instance u_1 might represent the phonetic articulation of a particular vowel, and w_1 could be the age of the speaker.

Then, the conventional associations between identities and styles in a particular community of practice can be modeled as a conditional probability distribution[2] $S_0(\mathbf{u}|\mathbf{w})$, with the job of a listener L to *infer* (using Bayes' rule) the social identity $\mathbf{w}$ of their interlocutor based on their style $\mathbf{u}$. In this respect, social meaning aligns with use-conditional meaning, a connection explored closely in (Qing and Cohn-Gordon, in press).

To say that linguistic features $(u_1 ... u_n)$ have social meaning in concert as a style, rather than separately, is to say that $S_0(u_1 ... u_n|w) \neq S_0(u_1|w) * ... S_0(u_n|w)$, i.e. that $u_1 ... u_n$ are not independent. Similarly, the aspects composing the interlocutor's social identity $(w_1 ... w_n)$ are not generally independent under the listener's prior or posterior.

To say that the meaning of a variant (or style) depends on context is to say that it depends on the conventions dictated by the S_0, as well as the prior beliefs about the speaker held by the listener, so that a particular feature u_1 may signal entirely different things depending on the context and the style it appear in.

Higher Order Indexes One particular way in which speakers signal their social identity is by using variants conventionally associated with a macrosocial category they do not belong to, in order to convey attributes associated with that category. For example, Eckert (2012) notes the use of urban-led sound changes (such as vowel backing and negative concord) by suburban teenagers who want to index perceived urban qualities:

> "...just as women are not making direct gender claims when they use female-led changes, burnouts are not making direct urban claims when they use urban-led changes...The urban kids that burnouts identified with were white kids who knew how to cope in the dangerous urban environment – kids they saw as autonomous, tough, and street-smart. Presumably in adopting urban forms, suburban kids were affiliating with those qualities, not claiming to be urban.".

We refer to this sort of use of a variant as *higher order indexicality*[3]. It allows for a speaker to exploit interspeaker variation in their communities of practice (for example, the fact that urban Detroit speakers use more negative concord) in order to communicate information other than just membership of a given macrosocial category.

[2]A distribution $P(A)$ over a set A is the pair (A, f), where f is a function $A \to \mathscr{R}$, assigning each element of A a real-valued weight between 0 and 1, such that $\sum_{a \in A} f(a) = 1$. A conditional distribution $P(A|B)$ is a function $B \to Dist(A)$, where $Dist(A)$ is the set of all possible distributions on A. In other words, a conditional distribution takes (i.e. is conditioned on) $b \in B$ and returns a distribution over A.

[3]This term is coined by (Silverstein, 2003), although our precise usage may differ.

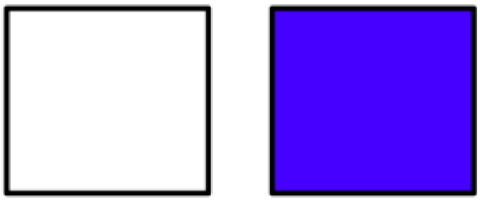

Figure 1: $U : \{square, blue\ square\}, W : \{R_1, R_2\}$

Our goal in this paper is to suggest a model of higher order indexicality, closely related to a Bayesian model of metaphor proposed by (Kao et al., 2014).

2. Bayesian Models of Semantics and Pragmatics

A body of recent work (often collectively referred to as the Rational Speech Acts, or RSA, framework) uses nested Bayesian models of speakers and listeners to formalize a number of the pragmatic phenomena envisioned by Grice (1975) to derive from inter-agent reasoning, such as scalar implicature (Frank and Goodman, 2012), manner implicature (Bergen et al., 2016), metaphor (Kao et al., 2014), hyperbole (Kao et al., 2014), and presupposition accommodation (Qing et al., 2016).

These models involves a correspondence between a set of possible worlds, W, and a set of possible utterances, U. A listener L_n hears an utterance $u \in U$ and infers what world $w \in W$ a hypothetical speaker S_n would have been in to have produced u. S_n, given a world w, chooses the utterance u that would cause a hypothetical L_{n-1} to infer w. This recursive process grounds out in a semantics, which states which utterances and worlds are compatible.

A simple two agent communicative task known as a *reference game* provides an example of linguistic communication that serves as a useful demonstration case for modeling semantics and pragmatics generally. We begin by summarizing the application of a simple RSA model to reference games, and show how this serves as a basis for richer models of linguistic communication.

In a reference game, a speaker and listener see a set W of referents. The speaker is assigned one of these referents as their target, and aims to communicate which referent this is to the listener. The speaker does so by choosing an utterance from a set U of possible utterances. Figure 1 provides a concrete example.

Assuming that both the speaker and listener share a semantics, so that *blue square* can only refer to R_2 while *square* can refer to either, the most informative utterance for a speaker whose target is R_2 is *blue square*.

A listener who assumes that the speaker acts informatively in this way can draw an inference on hearing *square*. They can infer that R_1 is the referent, since had R_2 been the referent, the speaker would have said *blue square*.

It is clear that a model of semantics is not sufficient to derive either the behavior of the informative speaker or the listener who reasons about this speaker. A speaker who only cares about producing true utterances will be equally inclined to say *blue square* or *square* when referring to R_2, since both are true. Likewise, a listener who only attends to semantics will be agnostic as to whether the intended referent is R_1 or R_2 on hearing *square*, since that utterance is compatible with either.

As such, what is needed is a model which formalizes the process of reasoning about one's interlocutor. We first consider a model of a listener who only reasons about a semantics, L_0:

(1) $L_0(w|u) = \frac{[\![u]\!](w)p(w)}{\sum_{w' \in W} [\![u]\!](w')p(w')}$

This model, on hearing *blue square*, is certain that the referent is R_2 (since $L_0(R_2|\textit{blue square}) = 1.0$), but on hearing *square*, does not draw any inference that the reference is R_1 (since $L_0(R_1|\textit{square}) = L_0(R_2|\textit{square}) = 0.5$).

A speaker S_1 can then be defined which given a referent w, prefers utterances u which convey w to L_0, so that $S_1(\textit{blue square}|R_2) > S_1(\textit{square}|R_2)$:

(2) $S_1(u|w) = \frac{L_0(w|u)p(u)}{\sum_{u' \in U} L_0(w|u')p(u')}$

This puts us in a position to define a new listener, L_1, capable of deriving the desired implicature by reasoning about what referent S_1 must have had in order to have produced the heard utterance:

(3) $L_1(w|u) = \frac{S_1(u|w)p(w)}{\sum_{w' \in W} S_1(u|w')p(w')}$

To make concrete predictions from our model, we must specify concrete values for U, W, $P(u)$, $P(w)$, and the semantics $[\![\cdot]\!]$, for instance as follows:

- $W : \{R_1, R_2\}$
- $U : \{\textit{square}, \textit{blue square}\}$
- $P(w) : \{R_1 : 0.5, R_2 : 0.5\}$
- $P(u) : \{\textit{square} : 0.5, \textit{blue square} : 0.5\}$
- $[\![\cdot]\!] : \{((\textit{blue square}, R_1), 0), ((\textit{blue square}, R_2), 1), ((\textit{square}, R_1), 1), ((\textit{square}, R_2), 1)\}$

Under this interpretation, L_1 prefers R_1 on hearing *square*, although R_2 is still a possibility: $L_1(R_1|\textit{square}) > L_1(R_2|\textit{square})$. This corresponds to the calculation of an implicature.

Projection Functions One important enrichment of the model in equations (1-3) is the L_1^{Q} model of metaphor. In the cases discussed so far, there has been a parameter left implicit that dictates which *aspects* of the world a speaker cares about conveying. For instance, the listener who hears "I ate some of the cookies." is modeled as drawing inferences about the number of cookies eaten, but not about whether it is raining in Timbuktu. We can make this dependence on an aspect of the world explicit by replacing S_1 with S_1^{Q}:

(4) $S_1^{\mathrm{Q}}(u|w,q) \propto \sum_{w'} \delta_{q(w)=q(w')} * L_0(w'|u)p(u)$

Here, q is a function of type $W \to \mathscr{P}(W)$, which maps a world w to an equivalence class of worlds. For instance, suppose that q maps a world to all the worlds in which John ate exactly the same number of cookies. Then the goal of S_1^Q is to be informative, but only up to the goal of conveying the number of cookies. The S_1^Q may mislead the listener with respect to the weather in Timbuktu, in the course of carrying out their goal.

Since q is an explicit variable on which S_1^Q depends, one can create a listener L_1^Q which *jointly reasons* about the world w and the aspect of the world q which the speaker wishes to communicate.

(5) $L_1^Q(w,q|u) \propto S_1^Q(u|q,w) * P(w) * P(q)$

This model was first proposed in (Kao et al., 2014) to model metaphor. The idea is that, in a metaphorical utterance like "John is a shark.", a listener reasons jointly about what John is like, and what *aspect* of John the listener was attempting to convey.

L_1^Q qualitatively differs from L_1 in the following way. It can hear an utterance u and infer a world w which is not compatible with u in the semantics. In particular, it can hear a metaphorical utterance like "John is a shark." and infer that the speaker meant to convey only some aspect of John, perhaps that he is vicious, and not another, like that he is able to breathe underwater (notated below as the property *aquatic*). The following interpretation of L_1^Q yields this behavior:

- $P(w)$: $\{(vicious, aquatic) : 0.2, (vicious, \neg aquatic) : 0.2,$ $(\neg vicious, aquatic) : 0.3, (\neg vicious, \neg aquatic) : 0.3\}$
- $P(U)$: $\{$*shark*: $\frac{1}{3}$, *vicious*: $\frac{1}{3}$, *aquatic*: $\frac{1}{3}\}$
- $P(q)$:
  - $q_{vicious}(\lambda(x,y) : x) : 0.5$
  - $q_{aquatic}(\lambda(x,y) : y) : 0.5$
- The semantics:
  - $[\![shark]\!](w) \mapsto 1$ if $w = (vicious, aquatic)$ else 0
  - $[\![vicious]\!](w) \mapsto 1$ if $w = (vicious, aquatic) \vee w = (vicious, \neg aquatic)$ else 0
  - $[\![aquatic]\!](w) \mapsto 1$ if $w = (vicious, aquatic) \vee w = (\neg vicious, aquatic)$ else 0

On hearing *shark* predicated of John, L_1's favored interpretation is that John is vicious but doesn't breathe underwater, and that the speaker is being informative about the viciousness dimension ($L_1^Q((vicious, \neg aquatic), q_{vicious}|shark) = 0.32$).

In this case, the model's behavior is very simple: the prior knowledge that John is unable to breathe underwater makes clear that $q_{aquatic}$ cannot be the value of q. More interesting dynamics arise when U includes a wider range of utterances, and W, a wider range of properties. The general behavior of L_1^Q, on receiving an utterance u is to try to find the pair (w,q) such that $q(w)$ is plausible under the prior but also such that no other utterance u' would better convey $q(w)$. For instance, "John is a shark" is unlikely to be interpreted to mean that John can swim well, even if it is plausible that he can, if there is an alternative utterance that would have conveyed this property better, like "swimmer".

3. Bayesian Models of Sociolinguistic Phenomena

3.1. A State Space of Speaker Identities

In the examples of RSA models in section (2), we interpreted $w \in W$ as the state of the world. The crucial move in applying RSA-style models to sociolinguistic phenomena is to interpret w as the social identity of the speaker, and $u \in U$ as the choices that a speaker makes (i.e. variants), which jointly carry information about their social identity.

More concretely, we model social identities (i.e. elements $w \in W$) as n-tuples of variables (following Burnett, 2017, 2019). Likewise, $u \in U$ are n-tuples of features. In the truth-conditional setting discussed above, a semantics (in the form of a compatibility relation) connects u to w, laying the basis for pragmatic enrichments from inter-speaker reasoning. This semantics is conventional knowledge in a given community of practice.

To model social meaning, we replace a relational semantics with a conditional probability distribution $S_0(u|w)$, which represents the *conventional stereotypes* about which types of people produce which types of language. Importantly, S_0, given a speaker with social identity w, is not a model of any speaker's actual language use but rather represents what all agents *treat* as such a speaker's model of language use.

The motivation for using an S_0 is discussed in more detail in (Qing and Cohn-Gordon, in press), as is the method by which it can be integrated into a model which also attends to truth-conditional meaning. For now, we simply observe that S_0 can be understood as representing the *conventional association between social identity and language* that is common ground in a given community of practice.

Thus a listener, on hearing their interlocutor speak, infers a joint distribution over the variables which describe the interlocutor's identity, by reasoning about S_0. For instance, children's speech differs along a number of features from that of adults, ranging from the realization of phones such as /r/, to the absence of complex syntactic constructions. This information is represented in S_0, which predicts that children will produce a child-like style of language. On hearing language with child-like style, L_0 can reason about S_0 to infer that the speaker is a child.

3.2. Modeling Higher Order Indexicality

The key feature of higher order indexicality is that a listener may hear a style u associated with some macrosocial category, and based on their prior belief about their interlocutor, draw an inference that they only possess certain attributes of this macrosocial category. For instance, hearing a child-like voice would not lead to the inference that the speaker is a child if they are known to be an adult. Instead, it might be taken to signal properties associated with children.

The L_0 model is insufficient to capture this sort of inference, since it has no mechanism for deciding what parts of a speaker's signaled identity are relevant. For instance, suppose personae consisted of just two Boolean variables: *youth* and *innocence*. Further suppose that the speaker

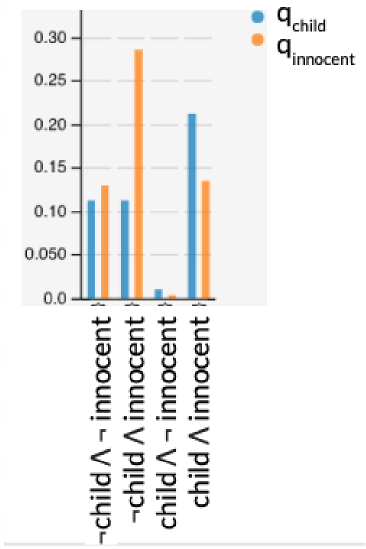

Figure 2: The L_1 posterior, after hearing their interlocutor produce language in a child-like style. The preferred interpretation is that the speaker is not a child, but is attempting to convey innocence. In this example, we do not strictly eliminate the prior possibility that the interlocutor might be a child, so the interpretation that this is the case also receives quite high probability.

is believed to be an adult. We encode this in the model through the listener's prior over W, as shown in (6). This prior prefers states w where *young* is false. It also encodes the correlation between being young and being innocent: when *young* is true, *innocent* is more likely to be true than when *young* is false.

(6) P(w): {(young=true, innocent=true): 0.15, (young=true, innocent=false): 0.05, (young=false, innocent=true): 0.35, (young=false, innocent=false): 0.45,}

(7) p(u): {child-like style: 0.5, adult style: 0.5}

Because L_0 assumes that S_0 is trying to communicate both dimensions (youth and innocence) of their own identity, L_0 will place high probability on both being true after hearing child-like language. By contrast, what we want is a model of a listener that can infer that the speaker only means to communicate about one of these dimensions, and is simply leveraging an index which has other associations.

This requires precisely the S_1^Q and L_1^Q models of (4) and (5). This is because S_1^Q allows for the production of utterances which are only true with respect to some aspect q of w, and L_1^Q is able to infer what this aspect is. In this setting, two projections are possible: $q_{young} = \lambda(x,y).x$ and $q_{innocence} = \lambda(x,y).y$. We set the distribution over these projections $p(Q)$ to uniform.

Because being young and being innocent are correlated in the L_0's prior, S_1^Q is able to use child-like language to communicate that they are innocent. This also has the effect of misleading L_0 with respect to whether the speaker is young, but if S_1^Q's projection is $q_{innocence}$ (i.e. they only care about being informative along the *innocence* dimension of meaning), this does not discourage S_1^Q from using the child-like style.

Thus, L_1^{Q}, because of its prior belief that the speaker is not a child, is able to rationalize the child-like language it hears from an adult speaker as a means of communicating the correlated attribute of innocence. As shown in figure 2, L_1^{Q} puts the most weight on $(w = (young : False, innocent : True), q = q_{innocence})$, after hearing a child-like style from an adult. This bears a close relation to the inference drawn when hearing a metaphor, such as "The party was a riot.", where only *some* aspects of *riot* are pertinent to the party, though the present model employs a distribution S_0 in place of a truth-conditional semantics.

While the example of child-like language given here is very simple, the core dynamic of the model can be extended to much richer cases of higher-order indexicality. For instance, female gender is associated with many different attributes and stances, any of which can be indexed, in an appropriate context, by female led sound changes.

4. Conclusion

The central idea of this paper, applying the L_1^{Q} model to higher-order indexicality, is part of a larger bridge between truth-conditional semantics and Gricean pragmatics on the one hand, and use-conditional and social meaning on the other. We argue that nested Bayesian models of speakers and listeners are the right tool to understand the similarities (e.g. the existence of a conventional association between form and meaning) and differences (whether this association is a compatibility relation or a conditional distribution). Our perspective connects indexicality with a larger system of non-linguistic semiotics, such as the use of fashion or body language to communicate social identity.

We envision developing this picture in future work, in several ways. One is to investigate how stylistic features are connected by a hierarchical latent variable. For instance, many aspects of stereotypical Californian style are related to displays of "low energy" , such as creaky voice, jaw setting, lengthened vowels, slow speech rate and so on. A hierarchical model, in which a latent "low energy" variable (possibly in concert with other variables) indexed the valley girl persona would be able to connect this variety of displays of low energy in a coherent way.

Another aim is to further develop the notion of social identities. Are the fundamental dimensions which make up identities socially constructed attributes, like gender, or seemingly objective ones, like geographic location, age, etc? A related question is diachronic: what is the process by which the commonly known conventions linking identity and linguistic style change over time and through use? As Coupland (2001) notes, "It is in relation to group norms that stylistic variation becomes meaningful; it is through individual stylistic choices that group norms are produced and reproduced" (2002:198).". From the perspective of the Bayesian models considered here, the natural modeling assumption corresponding to such change is to have uncertainty over the S_0 itself, so that through repeated interactions, agents gradually update their beliefs. Building models of this kind and applying them to real sociolinguistic data constitutes a promising avenue for further work.

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The polarity of clauses embedded under neg-raising predicates[1]

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Abstract. Neg-raising inferences, whereby negated attitude predicates like *don?t want to p* are strengthened to mean *want to not p*, have previously been derived assuming that negation is underlyingly positioned within the embedded clause, and undergoes movement into the matrix clause, being interpreted via reconstruction. These kinds of accounts contrast with accounts assuming that negation is interpreted in its surface position, and the neg-raising inference is derived via semantic/pragmatic inferential mechanisms, such as a homogeneity presupposition, without the use of movement. This paper constructs an argument for the latter approach based on the interpretation of *multi-dimensional* adverbial operators, i.e., adverbs with a not-at-issue meaning component, within neg-raising sentences. The paper suggests that such operators are invaluable tools for diagnosing the position and behavior of negation.

Keywords: neg-raising, not-at-issue content, negation, *as*-clauses, temporal adverbs, NPIs.

1. Introduction

(1) Do you think Donald Trump will end up serving his full term as president, or not?
   a. Think Donald Trump will end up serving his full term as president.
   b. Do not think Donald Trump will end up serving his full term as president.
   c. Not sure (Public Policy Polling, May 16, 2017)

The complement clause-embedding attitude predicates *think* and *sure* have similar meanings: they are often analyzed as doxastic necessity modals. But in (1b) and (1c), they behave differently when negated. *not think* in (1b) expresses *opinionatedness*. By choosing (1b) you intuitively are doxastically committed to the falsity of the embedded clause. The negated predicate *not sure* in (1c), on the other hand, expresses non-commitment.

Standardly, *think* is analyzed as a "neg-raising predicate" (NR-predicate), while *sure* is not (see, e.g., Horn, 1978). Negated NR-predicates like *not think that p* are strengthened to mean *think that not p*. I contrast two classes of accounts deriving the strengthened readings of NR-predicates, or *NR-inferences*.

The first type of account assumes negation is underlyingly in the subordinate clause, but raises in the overt syntax to the matrix clause. Negation is interpreted via reconstruction into its base position or some position within the scope of the attitude predicate (Fillmore, 1963; Collins and Postal, 2014, 2017, 2018a; Anvari et al., 2018, etc.). Throughout, I refer to these accounts as **low negation accounts**.

According to the second type of account, negation appears and is interpreted in its surface position, i.e., the matrix clause. NR-inferences are derived via semantic/pragmatic mechanisms and/or the lexical semantics of the NR-predicate (Bartsch, 1973; Gajewski, 2007; Romoli, 2013; Staniszewski, 2018, etc.). Throughout I refer to these types of accounts as **high negation accounts**. (2) is a schematization of these contrasting accounts.[2]

[1]With thanks to Amir Anvari, Dylan Bumford, Omri Mayraz, Todd Snider, four SuB reviewers and the audience at SuB 23 for helpful comments

[2]We also must consider the possibility that the strategies in (2) can co-exist within a single grammar, as proposed

(2) a. **Low-negation accounts**: [$_{MatrixCP}$ ... [NR-PRED [$_{Subord.CP}$ ... NEG ...]]]
b. **High-negation accounts**: [$_{MatrixCP}$ ... [NEG [... [NR-PRED [$_{Subord.CP}$ ...]]]]]

A key distinction between the two accounts: low negation accounts analyze the embedded clause as being negated, while high negation accounts do not. Thus the high negation account in (2b) predicts that there is a constituent [NR-PRED [$_{CP}$ ...]], consisting of the attitude plus the embedded clause which excludes negation.

This paper argues that evidence for such a constituent comes from what I refer to as *multi-dimensional operators*, that is, operators which add their scope as part of the not-at-issue content. Assume such a multi-dimensional operator **Op** modifies the NR-predicate. The two contrasting accounts are sketched in (3).

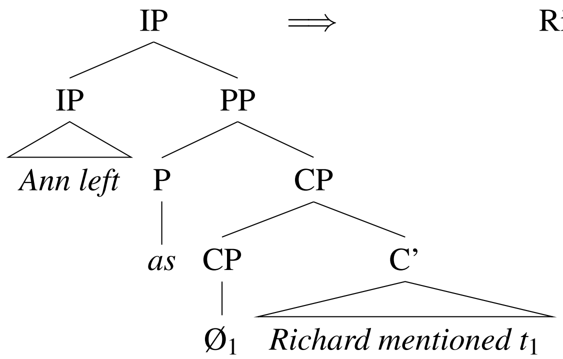
(3) a. **Low-negation**: [$_{MatrixCP}$ ... [**Op** [NR-PRED [$_{Subord.CP}$ ... NEG ...]]]]
b. **High-negation**: [$_{MatrixCP}$ ... [NEG [... [**Op** [NR-PRED [$_{Subord.CP}$ ...]]]]]]

In (3a), negation is placed into the not-at-issue content. But in (3b), negation is excluded from the not-at-issue content. Furthermore, not-at-issue content by definition 'projects' through negation.[3] Thus in (3b), the scope of the operator in the not-at-issue content will not be negated. This paper tests these predictions with respect to two multi-dimensional operators: (i) *as*-clauses, such as "*as Chris claimed*", and (ii) temporal adverbials like *anymore*.

This evidence, together with comparable evidence from ellipsis phenomena from Jacobson, 2018 forms an argument for the high negation account of NR-inferences. Further, the paper makes the broader claim that multi-dimensional operators are invaluable tools for diagnosing the position and behavior of negation.

2. *as*-clauses

The first sort of multi-dimensional operators under discussion are parenthetical *as*-clauses. Potts (2002) proposes that English *as*-clauses are PPs. The P '*as*' selects for a CP-sized clause, which contains null-operator movement to Spec,CP. The *as*-clause adjoins (left or right) to a VP- or IP-sized constituent. Assuming the VP-internal subject hypothesis (Koopman and Sportiche, 1991), these are constituents with propositional meanings. The semantic content of the *as*-clause is determined via composition with its syntactic sister.

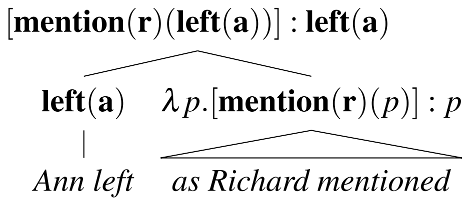
(4)


⟹ Richard mentions that <u>Ann left</u>

by Zeijlstra (2018), Collins and Postal (2018a), and Crowley (2019).
[3]By not-at-issue content, I am conflating a related but potentially diverse class of phenomena, what Tonhauser et al. (2013) refer to as 'projective content'.

Semantically, an *as*-clause is an identity function on propositions. Additionally, it determines that the content of the *as*-clause is part of the not-at-issue content.[4]

(5)

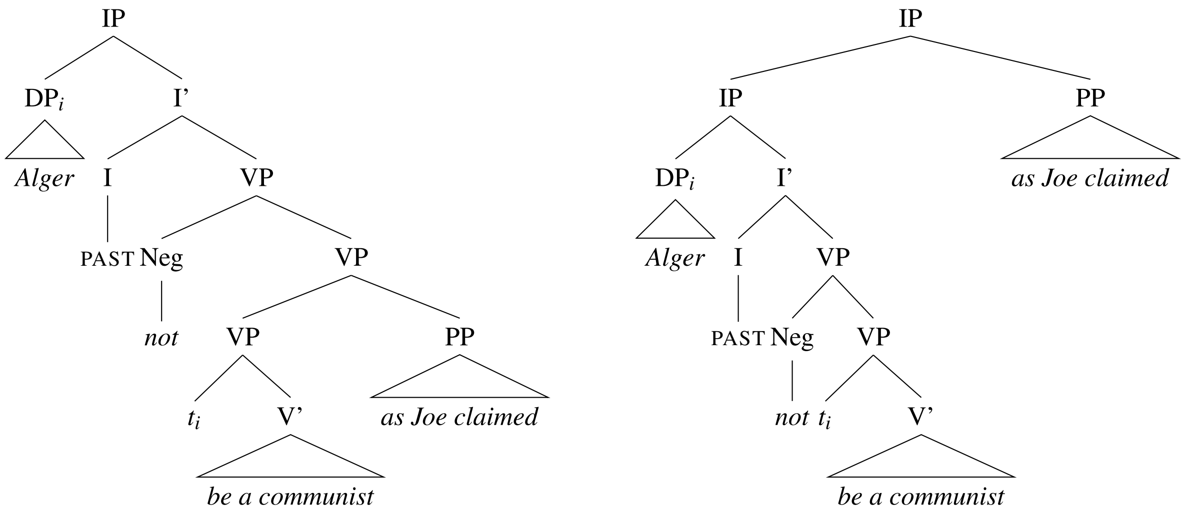


Potts observes that right-branching *as*-clauses create ambiguities when attached to negated clauses.

(6) Alger was not a communist, as Joe claimed.
  a. ⇝ Joe claimed: Alger was a communist.
  b. ⇝ Joe claimed: Alger was not a communist.

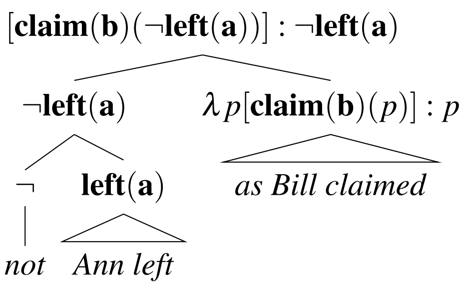
The ambiguity has a structural explanation: (6) can be parsed with the *as*-clause right adjoined above or below negation, as in (7).

(7)



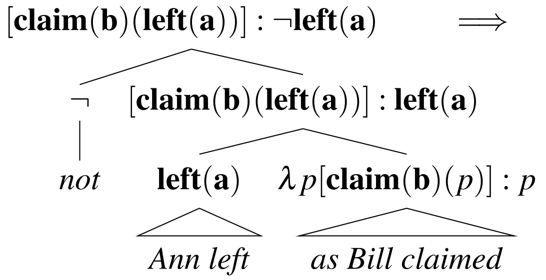
The structural ambiguity leads to the two different interpretations. In (8), but not in (9), negation is incorporated into the content of the *as*-clause.

(8)



$\Longrightarrow$ Bill's claim: "Ann didn't leave"

[4]The paper assumes a three-valued semantics, with a Weak Kleene semantics for connectives, such that $[\![Y]\!] = \#$ iff $[\![\neg Y]\!] = \#$. "$[Y] : Z$" is read as "Y is a definedness condition for Z". If $[\![Y]\!] = \mathrm{T}$, , then $[\![[Y] : Z]\!] = [\![Z]\!]$, else $[\![[Y] : Z]\!] = \#$. The definition follows Coppock and Beaver's (2015) for their $[\![\partial(Y) \wedge Z]\!]$. Most importantly, the definedness condition "projects through" negation: $[\![\neg([Y] : Z)]\!] = [\![[Y] : \neg Z]\!]$. See Coppock and Beaver (2015: 432).

(9) 

$\Longrightarrow$ Bill's claim: "Ann left"

We can immediately discount any potential analysis of *as*-clauses which assumes that they simply incorporate their sister's content with *either positive or negative polarity*. (10) below demonstrates that *as*-clauses are sensitive to the polarity of their host.

(10) Alger was a communist, as Joe claimed.
- a. $\rightsquigarrow$ Joe claimed: Alger was a communist.
- b. $\not\rightsquigarrow$ Joe claimed: Alger was not a communist.

We also don't analyze negation as a variable-scope-taking operator to account for the ambiguity. Ladusaw (1988) argues that both negation and certain adverbs have fixed scope. See (11)–(12), adapted from McCloskey (1997), in which the relative scope of the adverb and negation is strictly determined by linear order. If negation were able to take exceptional wide scope, we would wrongly predict that the (b) sentences are ambiguous.

(11)
- a. A fiat isn't necessarily reliable.
- b. A fiat necessarily isn't reliable.

(12)
- a. Shelley doesn't always do her homework.
- b. Shelley always doesn't do her homework.

McCloskey (1997) also notes that the surface position of negation rigidly determines its NPI-licensing properties. If negation could covertly take scope, we might expect (13b) to be acceptable.

(13)
- a. Which of the kids doesn't anybody like?
- b. *Which of the kids does anybody not like?

Potts' key evidence for a surface-structural approach to *as*-clause ambiguity comes from left-adjoined *as*-clauses. Here, according to Potts, the attachment site of the *as*-clause can be inferred from linear position. Thus, the structure is no longer ambiguous.[5]

(14) As Joe claimed, Alger did not meet a communist.
- a. $\not\rightsquigarrow$ Joe claimed Alger met a communist.
- b. $\rightsquigarrow$ Joe claimed Alger did not meet a communist.

(15) Alger did not, as Joe claimed, meet a communist.

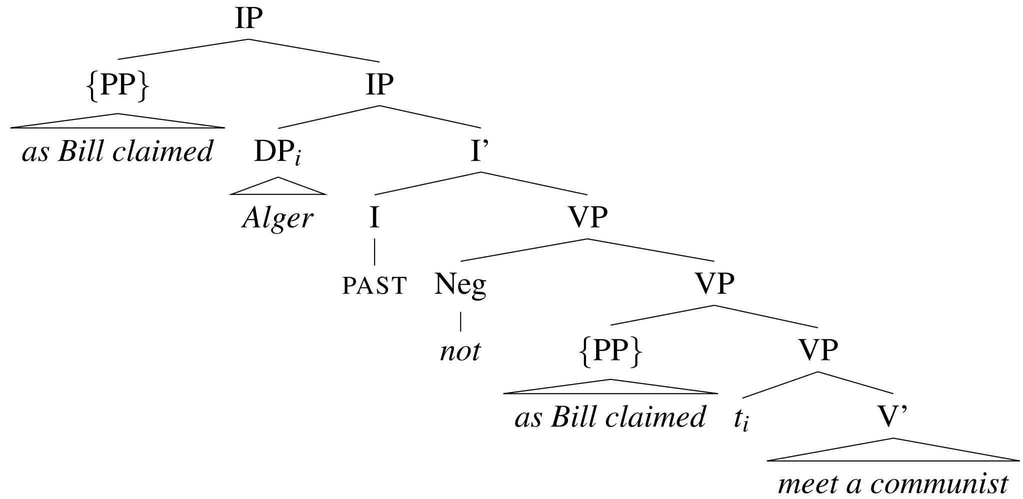
[5]There is a worry that (15) maybe be parsed as a slift, with "Joe claimed" embedding the entire constituent, thus incorporating negation into the content of the claim. To alleviate this, (15) can be embedded as in (ia). Slifts resist being embedded (ib), following Koev (2017).

(i)
- a. I realized that Alger did not, as Joe claimed, meet a communist.
- b. ??I realized that Alger didn't, Mary said, like Jazz.

a. ⇝ Joe claimed Alger met a communist.
b. ⇝̸ Joe claimed Alger did not meet a communist.

Depending on the height of attachment, the *as*-clause adjoins above or below negation, accounting for the interpretations in (14)–(15).

(16)



Due to their rigidity, *as*-clauses provide a valuable diagnostic for the position and scope of negation.

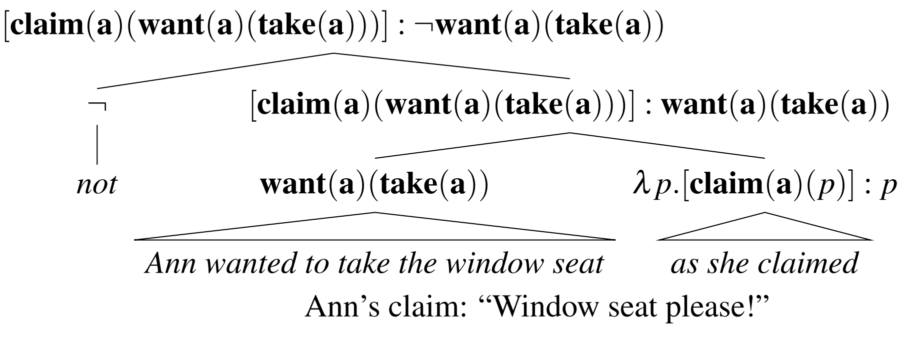
2.1. *as*-clauses and neg-raising

When *as*-clauses are combined with neg-raising predicates, we observe two relevant readings. The attitude is held with respect to a negated or non-negated complement.

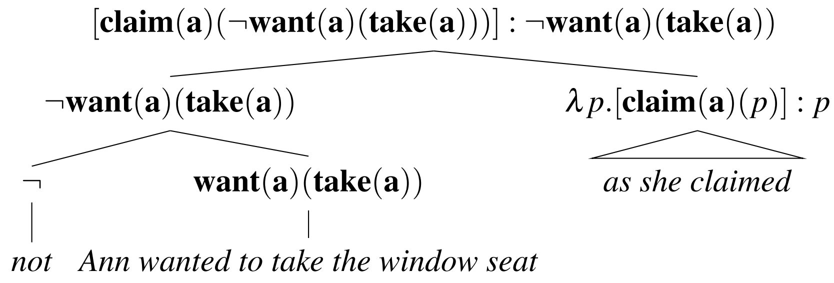
(17) Ann didn't want to take the window seat, as she claimed.
a. ⇝ Ann's claim: "I want to take the window seat" *Positive Claim Inference*
b. ⇝ Ann's claim: "I want to not take the window seat" *Negative Claim Inference*

The 'positive claim' reading shows that *as*-clauses can scope under negation but over the NR-predicate. The high-negation approach makes this scoping, [*not* ≺ *as-clause* ≺ *NR-pred*], possible. (18) demonstrates how the high negation account predicts this: negation cannot target the definedness condition. Only the asserted content is negated, deriving the 'positive claim' reading.

(18)



In contrast, the negative claim reading obtains when the *as*-clause scopes over negation, as in (19). Here, negation is included in the content of the *as*-clause.

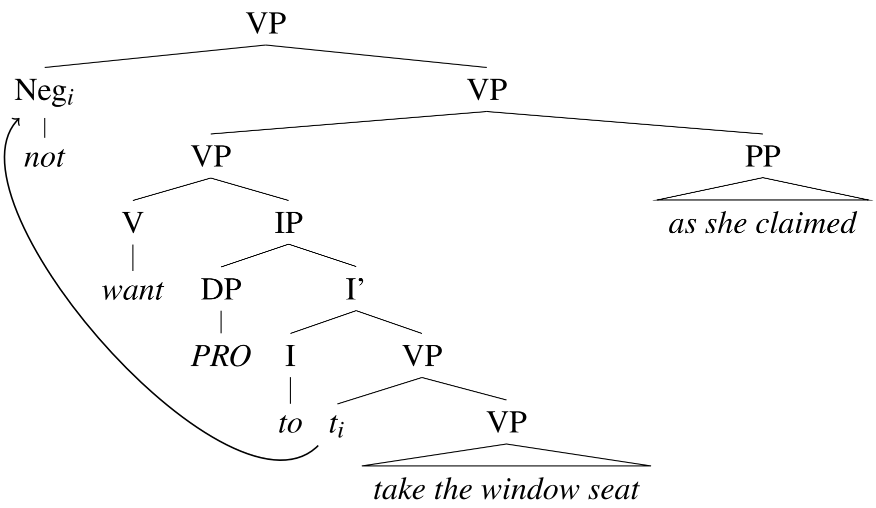
(19)


Ann's claim: "No window seat!"

In accordance with Potts (2002), *left*-adjoining the *as*-clause under negation, as in (20), forces the scoping in (18).

(20) Ann didn't, as she claimed, want to take the window seat.
   a. ⇝ Ann's claim: "I want to take the window seat" *Positive Claim Inference*
   b. ⇝̸ Ann's claim: "I want to not take the window seat" *Negative Claim Inference*

The high negation account permits a constituent whose interpretation includes the NR-predicate and its complement clause with positive polarity, such as "**want**(**a**)(**take**(**a**))" in (18). The low negation account does not permit this constituent as the subordinate clause is negated under such accounts. Negation is reconstructed below the attitude in an NR-structure. The *as*-clause scopes over the negation, incorrectly ruling out the positive claim reading. (21) sketches a low negation account of a NR-structure, with an *as*-clause.

(21)


Low negation accounts can derive the Positive Claim Inference ("Ann claims: I want the window seat") so long as negation is merged in the high position, higher than the attitude predicate, or alternative, if negation fails to reconstruct. With no additional mechanism for deriving NR-inferences besides movement of negation (plus reconstruction), negation is interpreted in the matrix position scoping *above* the attitude predicate, thus not deriving any NR-inference.[6]

[6]Approaches assuming that the low negation and high mechanisms for NR-inferences co-exist (Zeijlstra, 2018; Collins and Postal, 2018a; Crowley, 2019) allow an NR-inference here and so do not encounter this issue.

(22) [**claim**(**a**)(**want**(**a**)(**take**(**a**)))] : ¬**want**(**a**)(**take**(**a**))

¬ [**claim**(**a**)(**want**(**a**)(**take**(**a**)))] : **want**$^{\mathbf{a}}$(**take**(**a**))

not **want**(**a**)(**take**(**a**)) λp.[**claim**(**a**)(p)] : p

Ann wanted to take the window seat *as she claimed*

Ann's claim: "Window seat please!"
Ann has no desire for the window seat.

Low negation accounts derive the Positive Claim Inference by attaching negation high, and the NR-Inference by attaching negation low. Thus, the Positive Claim Inference should be mutually exclusive with the NR-Inference.

(23) **Low negation accounts' predictions**:
Ann didn't want to take the window seat, as she claimed.
a. *Reading 1* ⇝ Ann's claim: "I want to take the window seat"
⇝ Ann has no desire for the window seat.
(*Positive Claim*, ~~*NR*~~)
b. *Reading 2* ⇝ Ann's claim: "I want to not take the window seat"
⇝ Ann has a desire to not take the window seat.
(~~*Positive Claim*~~, *NR*)
c. *Reading 3* (ruled out) ⇝ Ann's claim: "I want to take the window seat"
⇝ Ann has a desire to not take the window seat.
(*Positive Claim*, *NR*)

But intuitively, (23) does not preclude *Reading 3* (i.e., Ann's positive claim does not preclude her being opinionated), contra the low negation accounts. This is more clear using the left-adjoined *as*-clause. Intuitively, (24) is compatible with Ann's being opinionated.

(24) Ann didn't, as she claimed, want to take the window seat.
a. ⇝ Ann's claim: "I want to take the window seat" *Positive Claim*
b. ⇝ Ann has a desire to not take the window seat. *NR-Inference*

Collins and Postal's (2017) version of the low negation account with an additional two negative operators in the matrix clause, sketched in (25), does not resolve this issue. The NR-inference is derived via the inclusion of an embedded-clause negation (which is rendered phonologically null by the matrix clause negations). Attaching the *as*-clause above the attitude in such a structure will derive a Negative Claim Inference, thus *Reading 3* above remains ruled out.

(25) **Double-negation account**:
$[_{MatrixCP}$ ... [NEG [NEG [NR-PRED $[_{Subord.CP}$ ... NEG ...]]]]]

2.2. NR-readings and NPIs

According to certain low negation accounts (e.g., Collins and Postal, 2014, 2017, 2018a, b), strong NPIs diagnose the presence of negation underlyingly in the subordinate clause. Lakoff (1969) states that strong NPIs cannot be licensed by negation across a clause boundary. In

(26) are judged as not acceptable, as in each case a strong NPI is separated from its potential licensor by a clause boundary.

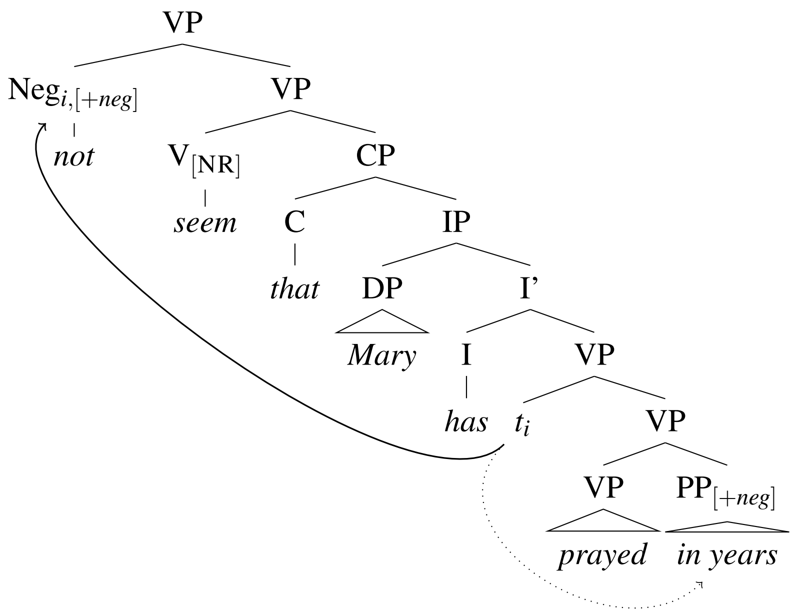
(26) a. ??It's not certain that writers can help smiling at that.
b. ??He didn't claim that he will get there until after the game.
c. ?*I didn't realize that Mary has prayed in years.

However, such NPIs are acceptable embedded under a neg-raising predicate.

(27) a. They don't think that writers can help smiling at that. (adapted from Horn 1978)
b. It's not likely that he will get there until after the game.
c. I don't suppose that I need mention this again.
d. She doesn't want to breathe a word about this.

Low negation accounts assume the strong NPI is licensed due to negation being reconstructed downstairs.

(28)



But even with a strong NPI in the embedded clause, *as*-clauses are still able to take scope over an embedded clause with positive polarity. We can simultaneously get both (i) a positive claim inference and (ii) an opinionatedness inference.

(29) [*Context*: John is a liar. He said Mary was likely to be gossiping about his drug habits, even though he knows it's most likely that she's been keeping it a secret.]
a. It isn't probable that she breathed a word about it, as John claimed.
(i) ⇝ John's claim "it's probable that she breathed a word about it".
(ii) ⇝ It's probable that she didn't say anything.
(*Positive Claim*, *NR*)
b. It isn't, as John claimed, probable that she breathed a word about it.
(i) ⇝ John's claim "it's probable that she breathed a word about it".
(ii) ⇝ It's probable that she didn't say anything.
(*Positive Claim*, *NR*)

(30) [*Context*: John is a liar. He has been telling everyone that Mary is deeply religious, even though she has not practiced any religion for a very long time.]
a. John doesn't think that Mary has prayed in years, as he claimed.
(i) $\rightsquigarrow$ John's claim "I think she has prayed at some point".
(ii) $\rightsquigarrow$ John believes she hasn't prayed in a long time.
(*Positive Claim*, *NR*)
b. John doesn't, as he claimed, think that Mary has prayed in years.
(i) $\rightsquigarrow$ John's claim "I think she has prayed at some point".
(ii) $\rightsquigarrow$ John believes she hasn't prayed in a long time.
(*Positive Claim*, *NR*)

The low negation account predicts these simultaneous inferences should not be possible. The positive claim inference requires negation to attach high. The presence of the NPI and the opinionatedness inference both require negation to attach low. But the evidence presented here points to negation being attached high.

3. The excluded middle assumption

A class of high negation accounts assume that negation scopes over the attitude predicate and, starting with Bartsch (1973), that the NR-Inference is derived by an *opinionatedness assumption*, either encoded as a (soft) presupposition (Gajewski, 2007) or as a grammaticalized scalar implicature (Romoli, 2013, Xiang, 2013). In short, a NR-predicate implies that the truth of the prejacent is settled in the relevant modal base. Here, following Gajewski, we can encode the opinionatedness assumption as a presupposition.

(31) $\textit{want} \rightsquigarrow \lambda p.\lambda x.[\mathbf{want}(x)(p) \vee \mathbf{want}(x)(\neg p)] : \mathbf{want}(x)(p)$

For readability, we can abbreviate the opinionatedness assumption like so:

(32) $\textit{want} \rightsquigarrow \lambda p.\lambda x.[\mathbf{opn}(\mathbf{want})(x)(p)] : \mathbf{want}(x)(p)$

The at-issue content has the effect of denying one of the disjuncts contributed by the opinionatedness assumption. The opinionatedness assumption together with the at-issue content gives rise to the following inferences via disjunctive syllogism. (34) shows how the account gives rise to an NR-Inference.

(33) [Ann$_i$ wants [*PRO*$_i$ to swim]] $\rightsquigarrow [\mathbf{opn}(\mathbf{want})(\mathbf{a})(\mathbf{swim}(\mathbf{a}))] : \mathbf{want}(\mathbf{a})(\mathbf{swim}(\mathbf{a}))$
$\models \mathbf{want}(\mathbf{a})(\mathbf{swim}(\mathbf{a}))$

(34) [Ann$_i$ wants [*PRO*$_i$ to swim]] $\rightsquigarrow [\mathbf{opn}(\mathbf{want})(\mathbf{a})(\mathbf{swim}(\mathbf{a}))] : \neg\mathbf{want}(\mathbf{a})(\mathbf{swim}(\mathbf{a}))$
$\models \mathbf{want}(\mathbf{a})(\neg\mathbf{swim}(\mathbf{a}))$

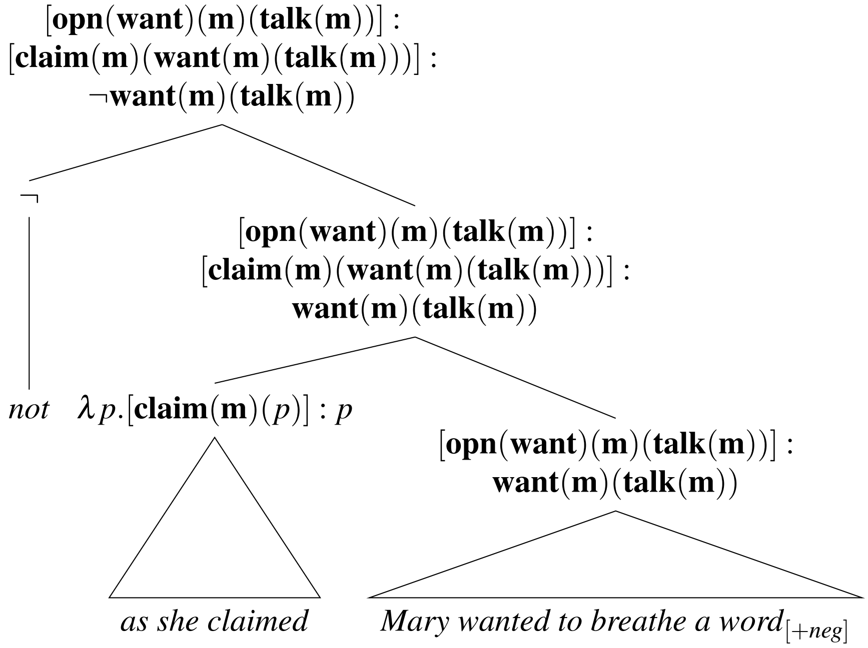
(34) expands as below, showing that the inference simply follows the schema: $p \vee q,\ \neg p,\ \therefore q$

(35) a. *Not-at-issue:* $\mathbf{want}(\mathbf{a})(\mathbf{swim}(\mathbf{a})) \vee \mathbf{want}(\mathbf{a})(\neg\mathbf{swim}(\mathbf{a}))$ $\quad p \vee q$
b. *At-issue*: $\neg\mathbf{want}(\mathbf{a})(\mathbf{swim}(\mathbf{a}))$ $\quad \neg p$
c. *Inference*: $\mathbf{want}(\mathbf{a})(\neg\mathbf{swim}(\mathbf{a}))$ $\quad \therefore q$

Under this account, we can derive the NR-Inference, via the **opn**-presupposition of the NR-predicate, and the Positive Claim Inference, as negation excluded from the *as*-clause content.[7]

[7]The $\mathbf{opn}(\mathbf{want})(\mathbf{m})(p)$ presupposition is also incorporated into the content of Mary's claim but this is excluded

(36)



NPIs like *in years* and *breathe a word* are understood as having existential meanings. They have syntactic licensing requirements, notated by a $_{[+neg]}$ feature. They must be c-commanded by an appropriate licensor.

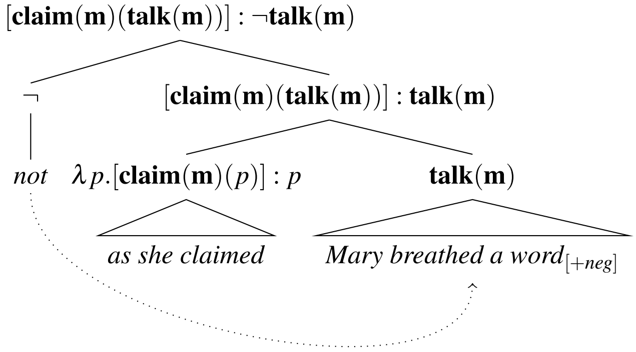
(37) a. *breathe a word*$_{[+neg]} \rightsquigarrow \lambda x.\exists y[\mathbf{talk}(y)(x)]$ (abbreviated as $\lambda x.\mathbf{talk}(x)$ above)
b. *in years*$_{[+neg]} \rightsquigarrow \lambda p.\lambda t.\exists t' \prec t[p(t')]$

The syntacticization of the account explains why NPIs are blocked from constituents preposed to the left of negation.

(38) a. Mary doesn't believe she has smoked in years.
b. *That she has smoked in years, Mary doesn't believe.
c. *That she has smoked in years isn't believed by Mary.

If an *as*-clause intervenes between the NPI and its licensor, its non-negated meaning is incorporated into the content of the *as*-clause. As the content of the *as*-clause (e.g., **talk**(**m**) below) is **not** present in the syntactic structure of the *as*-clause, the positive meaning of the NPI can arise without any violation of its syntactic licensing requirement.

(39)



for space. The NPI VP *breathe a word* is simply translated as **talk**; see (37a) below.

Finally, a brief word about accounts which assume that high negation and low negation derivations of NR-Inferences co-exist in a single grammar (Collins and Postal, 2018a (CP18), Crowley, 2019). CP18 assumes there are two paths to NR-Inferences: (i) negation can attach high, deriving an NR-Inference using the opinionatedness presupposition, or (ii) negation can also attach low, deriving an NR-Inferences using movement plus reconstruction.

We can also probe this theory with *as*-clauses. If the grammar made path (ii) available, we would expect (40) to be ambiguous: the *Negative Claim* reading derived by (moved) low negation. But it is ruled out.[8]

(40) George didn't think that, as Mary claimed, the children had left.
  a. $\rightsquigarrow$ Mary claimed the children had left. *Positive Claim Inference*
  b. $\not\rightsquigarrow$ Mary did not claim the children had left. *Negative Claim Inference*

We find that the unambiguous *Positive Claim* reading persists even with strict NPIs, providing evidence against the "dual paths" approach to NR-Inferences.

(41) a. George didn't think that, as Mary claimed, the children had prayed in years. $\rightsquigarrow$ Mary claimed the children prayed.
  b. George didn't think that, as Richard suspected, the children had breathed a word about it. $\rightsquigarrow$ Richard suspected the children talked.

4. Is neg-raising necessary for interclausal NPI licensing?

Under the high negation account, negation is in the matrix clause. So how does it license the strong NPI? Horn (2014) argues that the attitude's status as an NR-predicate is not a necessary condition for licensing strong NPIs inter-clausally. Such NPIs can be licensed across non-NR-predicates too, as in the following examples ($^\gamma$ denotes example pulled from the web).

(42) a. I can't <u>say</u> I've cooked myself a full meal <u>in weeks</u>, if not months. (Horn, 2014)
  b. I'm not <u>sure</u> he's done <u>a damn thing</u> to correct it. (Hoeksema, 2017)
  c. Crowne Plaza Hawkesbury Valley: Lovely setting but not <u>sure</u> would stay again <u>until renovated</u>$^\gamma$
  d. not <u>sure</u> I realized <u>until today</u> how much I really love little charm necklaces!$^\gamma$
  e. What if I'm not <u>sure</u> I can come <u>until just before the class</u>?$^\gamma$

Crucially, these examples express *non-opinionatedness*: the attitudes are not behaving semantically like NR-predicates. An account assuming that tautoclausal negation is necessary for strong NPIs is forced to say here that negation here can exceptionally move across a non-NR predicate, but this would entail that negation here does not reconstruct, in order to derive the non-opinionatedness (see the discussion in Collins and Postal, 2018b).

Hoeksema (2017) additionally shows strong NPIs are licensed in relative clauses, supposedly islands for movement. Thus a mechanism for interclausal licensing of strong NPIs is independently necessary.

[8] A possible counterpoint to this observation is to invoke a principle proposed in Seuren (1974) that for negation to undergo movement, it must be the highest scoping element in the clause. The high negation account derives the observation in (40) without this extra stipulation. Such a stipulation also leaves it unexplained why PPIs are licensed in NR-embedded clauses, see (45).

(43) a. He told me he didn't know of any specialists and gave no indication that he would lift a finger to try to find any for me.
b. Dave was totally circumspect, and we had no concern that he would breathe a word of it to anyone.
c. "We haven't found any evidence he's done a damn thing," said Wright.

Based on a corpus study, Hoeksema observes that 37/40 NPIs, including CP14's strict NPIs (e.g., *in years*, *until*, *in years*) are attested embedded under both neg-raising and non-neg-raising predicates. Non-neg-raising predicates which allow interclausal strict NPIs are themselves a verb class without clear delimitations at this point. Hoeksema points out that they are always non-factive. However, non-factivity is of course not sufficient: verbs of communication (*claim*, *state*, *mention*) fail to license interclausal NPIs. More work is needed to refine the class of non-NR predicates which license interclausal NPIs, termed by Collins and Postal (2018b) *cloud of unknowing predicates*.

Hoeksema also points out that PPIs are licensed under negated NR-predicates.

(44) a. We don't believe the shooters are still in the building.
b. The cops don't think they did something wrong.
c. I don't think the plane has already landed.

For negation-movement accounts, the contrast between (44) and (45) is unexplained. Note that (45) are supposed to be under the reading in which negation takes wider scope than the PPI.

(45) a. ?We believe the shooters are not still in the building.
b. ?*The cops think they didn't do something wrong.
c. ??I think the plane has not already landed.

Summing up, the data suggests that certain predicates which are *not* NR-predicates are able to license interclausal NPIs. This leads to the conclusion that a mechanism for interclausal licensing of NPIs is necessary, independent of any account of NR-phenomena. Further, negation movement-based accounts of NPI licensing are left to explain why NPIs are licensed across relative clause boundaries, and why PPIs are licensed under NR-predicates.

5. Temporal adverbs

As-clauses, when scoping between negation and an NR-predicate, are insightful for distinguishing the predictions of different theories of neg-raising. The NR-predicate plus its complement is placed in the not-at-issue content. Negation can only target at-issue content. Therefore, using *as*-clauses, we can observe the meaning of the NR-predicate's complement clause absent negation.

We can extend this kind of argumentation to other operators which scope in the configuration (46), and place their scope within not-at-issue content.

(46) [... [NEG [... [OP [... VP]]]]]

Here I identify another adverbial operator with these properties: the temporal adverb *anymore*. *anymore* is an NPI, at least in many varieties of English (including mine), so must be licensed by higher negative element. Under this paper's account, it takes scope over a temporal property *p* and presupposes that *P* has occurred at some point in the past.

(47) *anymore* $\rightsquigarrow \lambda p.\lambda i.[\exists i'(i' \prec i \wedge p(i'))] : p(i)$

In short, *anymore* takes scope over a proposition p. It presupposes p took place before the evaluation time (henceforth *backshifting*). Negation targets p, but not the presupposition.

(48) $\lambda i.[\exists i'(i' \prec i \wedge \mathbf{read}(\mathbf{j})(i'))] : \neg\mathbf{read}(\mathbf{j})(i)$

$\neg$ — *not*

$\lambda i.[\exists i'(i' \prec i \wedge \mathbf{read}(\mathbf{j})(i'))]] : \mathbf{read}(\mathbf{j})(i)$

$\mathbf{read}(\mathbf{j})$ — *John reads*

$\lambda p.\lambda i.[\exists i'(i' \prec i \wedge p(i'))] : p(i)$ — *anymore*

John doesn't read anymore.

When *anymore* combines with a NR-predicate, it can scope over the NR-predicate and its complement clause, but below negation. It is possible that in this configuration, the backshifted presuppositional content has *positive polarity*.

(49) John doesn't want to take the window seat anymore.
  a. $\rightsquigarrow$ John wants to not take the window now. *NR-Inference*
  b. $\rightsquigarrow$ John wanted to take the window seat before. *Positive Backshifted Inference*

Low negation accounts derive the NR-Inference with negation in the lower clause. So, why is the backshifted content not negated? On the other hand, under high negation accounts, negation is in the higher clause. Thus, the readings in (49) fall out naturally.

(50)

$\lambda i.[\mathbf{opn}(\mathbf{want})(\mathbf{j})(\mathbf{take}(\mathbf{j}))] :$
$[\exists i'(i' \prec i \wedge \mathbf{want}(\mathbf{j})(\mathbf{take}(\mathbf{j}))(i'))] :$
$\neg\mathbf{want}(\mathbf{j})(\mathbf{take}(\mathbf{j}))(i)$

$\neg$ — *not*

$\lambda i.[\mathbf{opn}(\mathbf{want})(\mathbf{j})(\mathbf{take}(\mathbf{j}))] :$
$[\exists i'(i' \prec i \wedge \mathbf{want}(\mathbf{j})(\mathbf{take}(\mathbf{j}))(i'))] :$
$\mathbf{want}(\mathbf{j})(\mathbf{take}(\mathbf{j}))(i)$

$[\mathbf{opn}(\mathbf{want})(\mathbf{j})(\mathbf{take}(\mathbf{j}))] :$
$\mathbf{want}(\mathbf{j})(\mathbf{take}(\mathbf{j}))$ — *John wanted to take the window seat*

$\lambda p.\lambda i.[\exists i'(i' \prec i \wedge p(i'))] : p(i)$ — *anymore*

Low negation accounts, like CP14, can say that high-negation structures like (50) are also possible, though mutually exclusive with a NR-Inference. But under those accounts, low negation is forced by strict NPIs.

Even with strong NPIs, the backshifted presupposition of *anymore* still has positive polarity, not predicted by the low negation accounts.[9]

(51) a. Sue doesn't want her to breathe a word about it anymore.
(i) ⇝ Now, Sue wants her to not talk. *NR-Inference*
(ii) ⇝ In the past, Sue wanted her to talk. *Positive Backshifted Inference*
b. Sue doesn't think Mary has prayed in years anymore.
(i) ⇝ Now, Sue thinks that she hasn't prayed. *NR-Inference*
(ii) ⇝ In the past, Sue thought she had prayed. *Positive Backshifted Inference*

These data are understandable under the scoping in (50). Negation is not underlyingly in the subordinate clause under a NR-predicate. NR-inferences emerge through pragmatic mechanisms like an excluded middle inference. NPIs like *breathe a word* and *in years* have an existential semantics, which must be negated in the asserted content, but can be non-negated in not-at-issue content.

6. Licensing NPIs upstairs

(49)–(51) are additionally problematic for the low negation account. *anymore* is an NPI in many dialects of English, thus it must be licensed by a wider scoping negative element.

If negation is in the lower clause (e.g., licensing the NPIs *breathe a word* and *in years*), then how is *anymore* licensed upstairs? Prince (1976) argues that a low negation account is preferable due to the unacceptability of (52). The NPI in the matrix clause *at all* is supposed to be unacceptable as negation is underlyingly low and so cannot license the higher NPI.

(52) *I don't at all think that John will leave until next week. (Prince's judgement)

But in my judgement, (52) is acceptable. (53) provides some web examples of *at all* licensed in the matrix clause of an NR-structure, contra Prince (1976) and Crowley (2019) which shares Prince's judgement.

(53) a. I don't at all think that we should banish these motivational phrases$^{\gamma}$
b. But, of course, we don't at all think that this fact renders your belief unjustified$^{\gamma}$
c. I don't at all think that Kavanaugh and Cosby are comparable$^{\gamma}$
d. I don't at all think that begging is as rife to-day as it was five years ago in Dublin$^{\gamma}$

In any case, whatever supposedly rules out (52) in Prince's and Crowley's judgements isn't a general property of NPIs. We find a variety of NPIs licensed in the matrix clause of NR-structures. For example, additive *either*:

(54) a. Kim doesn't want to leave, and I don't want to leave either.
b. Kim doesn't believe the exam is postponed, and I don't believe it is either.

Another class of examples: the "judge" argument of NR-evidentials like *seem*, *appear*, and *look like*. The judge argument, in the matrix clause, can be an NPI. Thus it must be licensed by

[9] The syntactic parses in (51) is somewhat obscured as *anymore* strongly prefers to be right-adjoined. Switching *anymore* for the near paraphrase *any longer* opens up the possibility of left-adjunction. (ia)–(ib) demonstrate the same point as above, allowing the NR-Inference and the Positive Backshifted Inference simultaneously (cf. Homer, 2015; Staniszewski, 2018 on *no longer*). Left-adjunction rules out any analysis involving a low attachment site for the adverb.

(i) a. Sue doesn't any longer believe that Jane will breathe a word about it.
b. Sue doesn't any longer think that Mary has prayed in years.

negation in the matrix clause. Negation in the subordinate clause will fail to license these NPs.

(55) a. It didn't seem to anyone else [that Chef Matsumoto prepared the best gelato].
b. It didn't appear to a single person there [that the performers would show up].

(56) are some naturally occurring examples of this construction.

(56) a. it should not appear to anyone [that we wish to claim more than is our due]$^{\gamma}$
b. It does not appear to anyone [that God is in charge]$^{\gamma}$
c. you will not sound to anyone [like you have a foreign accent]$^{\gamma}$
d. it doesn't look to anyone [like anything meaningful can possibly emerge from the seemingly endless random groups of data]$^{\gamma}$

Low negation accounts could say negation is merged in the matrix clause in the examples in (56). But these theories assume negation is merged low in the presence of strict NPIs. However, strict NPIs in the subordinate clause do not preclude NPI judge arguments in the matrix clause, contra low negation theories.[10]

(57) a. It didn't seem to anyone present [that John would lift a finger to help].
b. It didn't appear to a single member of the jury [that Ann had paid taxes in years].

The acceptability of the matrix clause NPIs falls out directly from the high negation account.[11]

The adjunction-site of *anymore* is obscured by its right-attachment. The Hebrew adverb *ba-xayim* 'in-life' linearly precedes the embedded clause, avoiding this confusion. I propose *ba-xayim* is an NPI temporally restricting its scope to the 'lifetime' of an individual as in (58). $\mathbf{life}(x)$ denotes a temporal interval beginning at x's birth/creation and ending at the time of evaluation.

(58) *ba-xayim* $\rightsquigarrow \lambda P.\lambda x.\lambda i.\exists i'[i' \subseteq [\mathbf{b}_x, i] \wedge P(x)(i')]$

(60) sketches the basic structure of (59). I'm assuming that the Hebrew verb undergoes head-movement to a position below negation, but is interpeted under reconstruction, thus the structure in (60).

(59) *Liran lo kara ba-xayim.*
Liran not read in-life
Liran never read in his life.

[10]Cf. Hoeksema (2017) who hedges on this point.

[11]Collins and Postal's (2017) low negation account which assumes covert double negation in the matrix clause doesn't resolve this issue, as double negation is generally not sufficient to license NPIs.

(i) a. ??No student didn't breathe a word about it.
b. ??Mary didn't not pray in years.

(60) $\neg\exists i'(i' \subseteq \mathbf{life}(\mathbf{l}) \wedge \mathbf{read}(\mathbf{l})(i'))$
- $\mathbf{l}$
  - *Liran*
- $\lambda x.\neg\exists i'(i' \subseteq \mathbf{life}(x) \wedge \mathbf{read}(x)(i'))$
  - $\neg$
    - *lo*
  - $\lambda x.\exists i'(i' \subseteq \mathbf{life}(x) \wedge \mathbf{read}(x)(i'))$
    - $\lambda P.\lambda x.\exists i'(i' \subseteq \mathbf{life}(x) \wedge P(x)(i'))$
      - *ba-xayim*
    - **read**
      - *kara*

Like *anymore*, *ba-xayim* must be licensed by a wider scoping non-UE expression. In (61), *ba-xayim* temporally restricts the NR-predicate *xašavti* 'I thought', but not the embedded predicate, which is a predicate whose truth is by nature not temporally restricted. Thus *ba-xayim* is most appropriately analyzed as being attached within the matrix clause. As *ba-xayim* is an NPI, it must be licensed by a higher negation. Low negation accounts of the neg-raising inference in (61) assume that the negative element *lo* is interpreted in the embedded clause. Thus, it is unclear how it both licenses and scopes over the matrix NPI *ba-xayim*.

(61) *ani lo xašavti ba-xayim* [*še-xameš hu mispar rišoni*].
1SG not think.1SG.PAST in-life COMP-five 3M.SG number prime
I didn't ever believe that 5 is a prime number.

(62) $\neg\exists i'(i' \subseteq \mathbf{life}(Sp) \wedge \mathbf{think}(\mathbf{prime}(\mathbf{5}))(Sp)(i'))$
- Sp
  - *ani*
- $\lambda x.\neg\exists i'(i' \subseteq \mathbf{life}(x) \wedge \mathbf{think}(\mathbf{prime}(\mathbf{5}))(x)(i'))$
  - $\neg$
    - *lo*
  - $\lambda x.\exists i'(i' \subseteq \mathbf{life}(x) \wedge \mathbf{think}(\mathbf{prime}(\mathbf{5}))(x)(i'))$
    - $\lambda P.\lambda x.\exists i'(i' \subseteq \mathbf{life}(x) \wedge P(x)(i'))$
      - *ba-xayim*
    - $\mathbf{think}(\mathbf{prime}(\mathbf{5}))$
      - *xašavti še-xameš hu mispar rišoni*

The same principle applies in (63), in which the embedded clause contains a strong NPI, *inkof estba*. Low negation accounts assume negation must be interpreted low in order to license the lower NPI, but are thus left to explain how the matrix NPI is licensed.

(63) *ani lo xašavti ba-xayim* [*še-Yossi inkof etsba lema'an-i*].
1SG not believed in-life COMP-Y. lift finger for-me
I never believed that Yossi would lift a finger for me.

Under high negation accounts of NR-inferences, it is expected that matrix NPIs are licensed.

7. Summary

The high negation and low negation accounts of NR-inferences come apart when we look at operators with a not-at-issue meaning component: in this paper, *as*-clauses and temporal adverbs. The study highlights the importance of multi-dimensional operators as a probe into compositional properties of various structures involving negation (cf. Jacobson's (2018) study of ellipsis). As not-at-issue content projects through operators like negation, we can use it strategically to examine content in the absence of negation. This strategy leads us to favor the high-negation accounts of NR-inferences.

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Third readings by semantic scope lowering: Prolepsis in Tiwa[1]

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Abstract. Tiwa (Tibeto-Burman; India) attitude reports allow for proleptic objects, base-generated in the matrix clause but semantically related to a bound pronoun in the embedded clause. Unlike prolepsis in German (Salzmann, 2017b) and Nez Perce (Deal, 2018), which only allow for classic *de re* readings of the proleptic object, Tiwa prolepsis supports both classic *de re* and third readings. We provide an analysis that derives third readings via semantic scope lowering, an analytical relative of semantic reconstruction, and consider cross-linguistic implications.

Keywords: attitude reports, third readings, prolepsis, *de re*, semantic variation, semantic fieldwork, Tiwa, Tibeto-Burman.

1. Introduction

Indefinites in attitude reports are in principle subject to three distinct readings. We can see this for the sentence in (1).

(1) Mary hopes that a friend of mine will win the race. (von Fintel and Heim, 2011:101)

Under the classic *de re* reading of (1), the indefinite embedded subject outscopes the attitude verb *hope*, and its restrictor *friend of mine* is evaluated with respect to the matrix evaluation world. This reading conveys that there is an (actual) friend of mine x such that Mary hopes x will win the race. The sentence is true on this reading when Mary considers a particular individual, who unbeknownst to her happens to be my friend, and hopes that individual will win. In contrast, under its classic *de dicto* reading, the attitude verb outscopes the indefinite, and *friend of mine* is evaluated with respect to Mary's hope-alternatives. This reading conveys that for any world w in which Mary's hopes from the actual world are realized, there is some individual who is a friend of mine in w and who wins the race in w. In contrast to the classic *de re* reading, the *de dicto* reading can be true even if I have no friends in the actual world, so long as Mary believes incorrectly that I do.

The third reading–what von Fintel and Heim (2011) call 'restrictor *de re*'–is intermediate between these two. On this reading, *hope* outscopes the indefinite embedded subject, like in the classic *de dicto* reading: Mary's attitude does not concern any particular actual individual. However, the restrictor *friend of mine* is not interpreted with respect to Mary's hope-alternatives, but is instead interpreted with respect to the evaluation world.[2] More precisely, the third reading of (1) conveys that in any world w in which Mary's hopes from the evaluation world are realized, there is some individual who is a friend of mine in the evaluation world (w_c), and who wins the race in w. A scenario in which the third reading is true, but not the classic *de re* or classic *de dicto* reading, is one in which Mary sees a group of strangers who she doesn't know are my friends, and without singling out any particular individual to pin her hopes on, simply hopes that someone from among that group will win the race.

[1]Thanks to Mary Maslai, Bibiana Maslai, and the rest of the Tiwa community at Umswai for sharing their language with us. Thanks also to audiences at UC Berkeley and Sinn und Bedeutung 23 for feedback and comments.
[2]We abstract away from certain complexities for this characterization raised by Schwager (2010).

The third reading of (1) crucially involves a surface scope configuration for the attitude verb and the embedded indefinite quantifier. Compositional approaches to this reading have therefore tended to leave the quantifier itself *in situ* under the attitude verb while manipulating the modal evaluation of the NP predicate, for instance by composing the NP with a non-locally bound world variable (Percus, 2000) or by replacing the NP outright (Schwager, 2010, cp. Baron, 2016). Von Fintel and Heim (2011) consider an alternative strategy, in which the indefinite quantifier raises to a position above the attitude verb (allowing the predicate to be interpreted outside the scope of the attitude verb), but semantically reconstructs (deriving the narrow-scope reading of the quantifier). This style of analysis for (1) is represented in (2).

(2) λw [a friend$_w$ of mine] $\lambda Q_{\langle et,t\rangle}$ [Mary hopes$_w$ [that $\lambda w'$ t_Q will win$_{w'}$ the race$_{w'}$]]

Here, binding of a high-typed variable results in lowered scope for the quantifier, while the NP restrictor is evaluated independently of the modal quantification.

In this paper, we argue that semantic scope lowering of this general type corresponds to an attested natural language strategy for producing third readings. Specifically, we demonstrate that in Tiwa, a Tibeto-Burman language of India, third readings are possible in **prolepsis constructions**. In such constructions, a notional argument of the embedded predicate is base-generated in the matrix clause (Higgins, 1981; Ingria, 1981; Takano, 2003; Davies, 2005; Salzmann, 2017a, b). We provide a first Tiwa example of this type of structure in (3):

(3) Context: *Mukton payârjíng lína mon cha.* ‘Mukton does not want to go outside.’

pro$_j$ [$_{VP}$ [$_{V'}$ **kishá khódo-gô**$_i$ atkhâl lá-ga,] [$_{CP}$ *pro*$_i$ pe-go$_j$ chi-w
3SG [[one mosquito-ACC think-PFV] [3SG 3SG-ACC bite-NEUT
honmandé.]
COMP]
‘He thinks a mosquito will bite him.’

We will defend three claims about sentences like (3). First, the bolded accusative argument (here *kishá khódogô* ‘a mosquito’) is never syntactically embedded; it is base-generated in the matrix clause. Second: despite its syntactic position, the quantifier in the bolded argument may scope under the verb. For this particular example, this means that there need be no particular mosquito that Mukton has a belief about. Third: the restrictor of the bolded argument nevertheless cannot be interpreted only with respect to the worlds quantified over by the attitude verb. That is, (3) cannot receive a classic *de dicto* reading. The truth of this sentence requires that the evaluation world contains mosquitos. Overall, while the high base generation site of the indefinite can explain why the NP restrictor is interpreted independently of the modal quantification, the low scope of the quantifier itself calls for a semantic lowering strategy.

The paper is structured as follows. In §2 we provide some brief background details about the Tiwa language along with an in-depth look at the syntax of Tiwa attitude reports, providing evidence for a prolepsis structure. In §3 and §4, we turn to the meaning of prolepsis sentences and their compositional origins. First, we show that proleptic structures support classic *de re* readings, but not classic *de dicto* readings, and provide a compositional analysis that accounts for this (§3). Then, we show that these structures do allow for third readings of the proleptic object, and propose an account in terms of semantic scope lowering (§4). We conclude in §5.

2. The syntax of Tiwa attitude reports

Tiwa is a Tibeto-Burman language spoken by approximately 27,100 people in Assam state, northeast India.[3] The data here were collected between 2016 and 2018 by the first author. These data are based on work with two speakers, both from Pundurimakhâ village in Umswai, Assam. The crucial data were obtained as felicity judgments in context (see Matthewson, 2004), and were confirmed across the two speakers separately.

Aspects of Tiwa grammar are described in Joseph (2014), Dawson (2017), and Dawson (2018). Tiwa has basic SOV word order, with accusative case alignment. Subjects are bare (nominative), and objects are marked with the accusative case suffix *-gô*. Some scrambling and extraposition are permitted, leading to word order variation (e.g. SVO, OSV). *Pro*-drop is frequent, and both subjects and objects can be omitted.

Tiwa has many attitude verbs that take a finite CP complement. A sample of these verbs is given in (4). In this paper, we will focus on *atkhâl lá* 'think' and *si* 'know', but as far as we know, the generalizations described here hold for all attitude verbs in Tiwa.

(4) *atkhâl lá* 'think', *si* 'know', *nol* 'believe', *hon* 'say', *khosói mán* 'remember', *plaw* 'forget', *sóng* 'ask/tell', *athâma nang* 'be wonderstruck', *akhâ rí* 'hope', …

Structures including these verbs come in two syntactic varieties. The first is a simple intransitive structure in which CP complement appears post-verbally, as in (5).

(5) Mukton atkhâl lá-ga, [kráng tonga masú payâr-o thái-do honmandé.]
Mukton think-PFV wing having cow outside-LOC stay-IPFV COMP
'Mukton thinks there's a winged cow outside.'

The second structure features an accusative element surfacing in the matrix clause (bolded throughout this paper) along with a bound element in the embedded clause to which this object is semantically related, in a way to be made precise. In this section, we use coindexation as an informal device to indicate this semantic relationship. This kind of construction is illustrated in (6) and (7). Note that the matrix-level object must be marked accusative; the bound element in the embedded clause may be either an overt pronoun or a null one.[4]

(6) Maria **Saldi*(-go)**$_i$ atkhâl lá-ga, [$_{CP}$ pe$_i$ lí-ga honmandé.]
Maria Saldi-ACC think-PFV 3SG go-PFV COMP
'Maria thought that Saldi went.'

(7) Sonali **Mansing-go**$_i$ atkhâl lá-ga, [$_{CP}$ *pro*$_i$ lí-ga honmandé.]
Sonali Mansing-ACC think-PFV 3SG go-PFV COMP
'Sonali thinks that Mansing left.'

The bound pronoun can be in any syntactic position in the embedded clause. In the examples above, it was the subject of the embedded clause. (8) shows the bound pronoun in object position, and (9) shows it as the complement of a postposition in a comparative.

[3]This population estimate is from the 2001 Indian census, as reported in Ethnologue (Simons and Fennig, 2017).

[4]We can generalize that *pro*-drop in this environment behaves exactly as it does elsewhere in the language. For instance, null pronouns are never allowed as the complement of a preposition in Tiwa. This restriction holds in the structures we are looking at as well, e.g. in (9), where the pronoun must be overt.

(8) Maria **John-go**$_i$ atkhâl lá-ga, [Saldi *pro*$_i$ lak mán-ga honmandé.]
Maria John-ACC think-PFV Saldi 3SG meet-PFV COMP
'Maria thinks that Saldi met John.'

(9) Mansing **Mukton-go**$_i$ atkhâl lá-ga, [Lastoi [$_{PP}$ pe-na$_i$ khúli] parâ chu-w honmandé.]
Mansing Mukton-ACC think-PFV Lastoi 3SG-DAT than more tall-NEUT COMP
'Mansing thinks that Lastoi is taller than Mukton.'

Crucially, a matrix object is only allowed so long as there is a bindable element in the embedded clause. This is shown in (10) and (11).[5]

(10) *Lastoi **Modi-go** atkhâl lá-ga, [India tes-e economy thángane cha honmandé.]
Lastoi Modi-ACC think-PFV India country-GEN economy good NEG COMP
Intended: 'Lastoi thinks regarding Modi that the Indian economy is not doing well.'

(11) *Maria **John-go** atkhâl lá-ga, [Saldi lí-ga honmandé.]
Maria John-ACC think-PFV Saldi go-PFV COMP
Intended: 'Maria thinks regarding John that Saldi left.'

Note that the ungrammaticality of (10) and (11) provides evidence against a parse of (5) as including a silent (*pro*) accusative argument. In the absence of a bindable element in the embedded clause, a matrix accusative (overt or null) will not be permitted. We conclude that attitude reports in Tiwa come in two distinct syntactic forms, one but not the other of which is required to contain an embedded bindable element.

In the remainder of this section, we argue for a prolepsis analysis of the attitude report type featured in (6)-(9). We first argue that the bolded accusative is syntactically in the matrix clause (§2.1), and then that it is base-generated there, not moved (§2.2). This sets the stage for our semantic investigation of prolepsis constructions in sections 3 and 4.

2.1. The proleptic object is syntactically upstairs

The bolded accusative object shows a variety of syntactic behaviors indicative of a position in the matrix clause. We will present five in detail here.[6] The first piece of evidence comes from case marking: the bolded argument must be marked accusative even when the verb in the embedded clause is intransitive. This is shown in (12). (13) shows that the embedded verb *lí* 'go' cannot take an accusative-marked subject ordinarily, suggesting that the accusative case marking on *Mansing* in (12) comes from the matrix verb.

[5]These examples make for a contrast with the type of English 'prolepsis' construction discussed by Davies (2005), e.g. *I believe about Richard that he and Linda are in trouble* (Davies' example), given the well-formedness of the English translations. Tiwa's pattern in this respect is similar to that of Nez Perce, as discussed by Deal (2018).

[6]For space reasons, we omit additional evidence from Condition B, and the double accusative constraint (see Harada, 1973, among many others, on this constraint in Japanese).

(12) Sonali **Mansing*(-go)**$_i$ atkhâl lá-ga, [*pro*$_i$ lí-ga honmandé.]
Sonali Mansing-ACC think-PFV 3SG go-PFV COMP
'Sonali thinks that Mansing left.'

(13) **Mansing(*-go)** lí-ga.
Mansing(*-ACC) go-PFV
'Mansing left.'

The second piece of evidence comes from word order. Typically, the accusative argument appears directly before the matrix verb, as in (14a), in canonical object position. It can also appear after the matrix verb, as in (14b). This pattern is consistent with the behavior of objects in regular clauses, which usually appear pre-verbally, but can also appear post-verbally, as shown in (15).

(14) 'Saldi thinks that it was in the market that Mansing saw Lastoi.'
a. Saldi **Mansing-go**$_i$ atkhâl lá-ga, [*pro*$_i$ hat-o Lastoi-go nú-ga
Saldi Mansing-ACC think-PFV 3SG market-LOC Lastoi-ACC see-PFV
honmandé.]
COMP
b. Saldi atkhâl lá-ga **Mansing-go**$_i$, [*pro*$_i$ hat-o Lastoi-go nú-ga
Saldi think-PFV Mansing-ACC 3SG market-LOC Lastoi-ACC see-PFV
honmandé.]
COMP

(15) 'Saldi saw Mansing.'
a. Saldi **Mansing-go** nú-ga.
Saldi Mansing-ACC see-PFV
b. Saldi nú-ga **Mansing-go**.
Saldi see-PFV Mansing-ACC

The central word order evidence for a matrix clause position comes from examples where the bolded accusative argument appears to the right of embedded clause material, as shown in (16a). Such strings are ungrammatical. They can be rescued if the argument is nominative, as in (16b), as it can then be construed syntactically as the subject of the embedded clause.

(16) 'Saldi thinks that it was in the market that Mansing saw Lastoi.'
a. *Saldi atkhâl lá-ga, [hat-o **Mansing-go**$_i$ *pro*$_i$ Lastoi-go nú-ga
Saldi think-PFV market-LOC Mansing-ACC 3SG Lastoi-ACC see-PFV
honmandé.]
COMP
b. Saldi atkhâl lá-ga, [hat-o Mansing Lastoi-go nú-ga honmandé.]
Saldi think-PFV market-LOC Mansing Lastoi-ACC see-PFV COMP

The third argument for a matrix clause position comes from prosody. There is a distinct prosodic break between the matrix clause and the post-verbal embedded clause, indicated above with a comma. When the bolded accusative argument appears postverbally, it is prosodically grouped with the matrix clause, as in (14b) above. This follows from constituency if prosodic boundaries are by default read off of syntactic ones, especially at the clausal level (Selkirk, 1995).

NPI licensing provides the fourth piece of evidence for a matrix position. Tiwa has a strong NPI *sharbo* 'nobody' that is licensed by clausemate negation, as shown in (17).[7]

(17) a. Maria **shar-go-bo** nú-$\boxed{\text{ya}}$-m.
Maria who-ACC-ADD see-NEG-PST
'Maria didn't see anyone.'

b. *Maria **shar-go-bo** lak mán-ga.
Maria who-ACC-ADD met-PFV

The bolded accusative can be a strong NPI so long as there is negation in the matrix clause, as in (18a). The NPI is not licensed by negation in the embedded clause, as shown in (18b), again suggesting that it is in the matrix clause syntactically.

(18) a. Saldi **shar-go-bo**$_i$ atkhâl lá-$\boxed{\text{ya}}$-m, [*pro*$_i$ hat-jíng lí-ga honmandé.]
Saldi who-ACC-ADD think-NEG-PST 3SG market-ALL go-PFV COMP
'Saldi doesn't think that anyone went to market.'

b. *Saldi **shar-go-bo**$_i$ atkhâl lá-ga, [*pro*$_i$ hat-jíng lí-$\boxed{\text{ya}}$-m honmandé.]
Saldi who-ACC-ADD think-PFV 3SG market-ALL go-NEG-PST COMP
Intended: 'Saldi thinks that nobody went to market.'

The fifth argument for matrix clause position comes from Condition A effects. If the bolded accusative is an anaphor, it must be bound by the matrix subject, as shown in (19a). By contrast, if an anaphor occurs inside the embedded CP, it must be bound by the embedded subject, (19b). This contrast provides strong evidence that the bolded accusative in (19a) is in the matrix clause.

(19) a. Mansing$_i$ **othông-go**$_{i/*j}$ atkhâl lá-ga, [Lastoi$_j$ *pro*$_{i/*j}$ nú-ga honmandé.]
Mansing self-ACC think-PFV Lastoi 3SG see-PFV COMP
'Mansing$_i$ thought Lastoi$_j$ saw him$_{i/*j}$.'

b. Mansing$_i$ atkhâl lá-ga, [Lastoi$_j$ othông-go$_{*i/j}$ nú-ga honmandé.]
Mansing think-PFV Lastoi self-ACC see-PFV COMP
'Mansing$_i$ thought Lastoi$_j$ saw herself$_{*i/j}$.'

These binding facts furnish a first indication that movement is not involved in cases like (19a). Specifically, if there were movement of the bolded argument from the embedded clause to the matrix clause, we might expect possible reconstruction for binding purposes in (19a), making *Lastoi* a possible antecedent. There is language-internal evidence that anaphors can reconstruct for binding purposes in Tiwa in clause-bounded scrambling. This is shown in (20b), in which the object anaphor has scrambled above the subject, but undergoes reconstruction for binding.

(20) 'I saw myself in the mirror.'

a. Ang$_i$ **othông-go**$_{i/*j}$ ainâ-w nú-ga.
1SG self-ACC mirror-LOC see-PFV

b. **Othông-go**$_{i/*j}$ ang$_i$ ___ ainâ-w nú-ga.
self-ACC 1SG mirror-LOC see-PFV

That reconstruction is not available for (19a) suggests that the anaphor was base-generated in the matrix clause. In the next section, we make two further arguments for this analysis.

[7] Note that *sharbo* is clearly bimorphemic: it consists of the *wh*-word *shar* 'who' plus an additive particle *bo* 'also/even'.

2.2. Base-generation, not movement

In general, the surface position of the bolded argument as the object of the matrix clause is compatible with two major classes of hypotheses: either the argument moved to the matrix clause from the embedded clause (e.g., raising to object), or it was base-generated there (prolepsis). In this section, we present two additional pieces of evidence (beyond the Condition A argument just above) that suggest the bolded argument is base-generated in the matrix clause.

The first argument against a movement analysis concerns overt bound pronouns inside the embedded clause. This is shown in (21) and (22), as well as in several examples above.

(21) Maria **Saldi-go**$_i$ atkhâl lá-ga, [**pe**$_i$ lí-ga honmandé.]
Maria Saldi-ACC think-PFV 3SG go-PFV COMP
'Maria thought that Saldi went.'

(22) Maria **ang-go**$_i$ atkhâl lá-ga, [**pe**$_i$ chigál-ya-m-lô honmandé.]
Maria 1SG-ACC think-PFV 3SG get.up-NEG-PST-FOC COMP
'Maria thought that I did not get up.'

While the presence of an overt pronoun (rather than a gap) is fully expected on a prolepsis analysis, it is surprising from the perspective of a movement analysis. Pronominal resumption is generally impossible in otherwise clear instances of movement in Tiwa, such as long distance scrambling. This is illustrated in (23). (23a) is the baseline example, with an embedded CP and no long-distance scrambling. (23b) shows that long distance scrambling from the embedded CP is possible; the dative argument *Mukton-a* has scrambled to the front of the matrix clause. (23c) shows that pronominal resumption in the position that *Mukton-a* moved from is ungrammatical.

(23) 'Saldi thinks that Lastoi gave Mukton a flower.'

a. Saldi atkhâl lá-ga, [Lastoi **Mukton-a** khum os-ga honmandé.]
Saldi think-PFV Lastoi Mukton-DAT flower give-PFV COMP

b. **Mukton-a**$_i$, Saldi atkhâl lá-ga, [Lastoi t_i khum os-ga honmandé.]
Mukton-DAT Saldi think-PFV Lastoi flower give-PFV COMP

c. ***Mukton-a**$_i$, Saldi atkhâl lá-ga, [Lastoi **pe-na**$_i$ khum os-ga honmandé.]
Mukton-DAT Saldi think-PFV Lastoi 3SG-DAT flower give-PFV COMP

The second argument for a base-generation approach concerns island effects: the embedded argument that is semantically linked to the matrix accusative can be inside an island. (24) shows this for a coordinate structure; the matrix accusative *Monbor-go* is associated with a pronoun in a coordinated DP.

(24) Lastoi **Monbor-go**$_i$ atkhâl lái-do, [[pe$_i$ arô Milton] Sonali-gô han sha-w
Lastoi Monbor-ACC think-IPFV 3SG and Milton Sonali-ACC love-NEUT
honmandé.]
COMP
'Lastoi thinks that Monbor and Milton love Sonali.'

The same facts hold for conditional islands, as illustrated in (25), and relative clause islands, as illustrated in (26).

(25) Milton **Sonali-go**$_i$ atkhâl lái-do, [*pro*$_i$ phi-gaido, Mansing khâdu-gam
Milton Sonali-ACC think-IPFV 3SG come-COND Mansing happy-CF
honmandé.]
COMP
'Milton thinks that if Sonali comes, Mansing would be happy.'

(26) **Mukton-go**$_i$ Saldi atkhâl lá-ga, [[$_{RC}$ pe-na$_i$ khum os-a] margî lí-ga
Mukton-DAT Saldi think-PFV 3SG-DAT flower give-NMLZ woman go-PFV
honmandé.]
COMP
'Saldi thinks that the woman who gave a flower to Mukton went.'

Note that clear instances of movement, such as long-distance scrambling, are impossible from all these environments in Tiwa. This is illustrated for each environment in (27)-(29) below.

(27) ***Mukton-a**$_i$, Saldi atkhâl lá-ga, [Lastoi pe-na$_i$/t_i arô Tonbor-a khum os-ga
Mukton-DAT Saldi think-PFV Lastoi 3SG-DAT and Tonbor-DAT flower give-PFV
honmandé.]
COMP
Intended: 'Saldi thinks that Lastoi gave Mukton and Tonbor a flower.'

(28) ***Mukton-a**$_i$, ang atkhâl lá-ga, [Saldi t_i khum os-gaido, thang-o honmandé.]
Mukton-DAT, 1SG think-PFV Saldi flower give-COND good-NEUT COMP
Intended: 'I think that if Saldi gives Mukton a flower, it will be good.'

(29) ***Mukton-a**$_i$, Saldi atkhâl lá-ga, [[t_i khum os-a] margî lí-ga honmandé.]
Mukton-DAT Saldi think-PFV flower give-NMLZ woman go-PFV COMP
Intended: 'Saldi thinks that the woman that gave a flower to Mukton left.'

In this section we have shown that the bolded accusative is base generated in the matrix clause: these are proleptic structures. Accordingly, we will refer henceforth to the bolded accusative DP as the *proleptic object*. In the next two sections, we turn to the range of interpretations these objects can receive.

3. Interpreting prolepsis: classic *de re* vs *de dicto*

The choice of a proleptic structure for an attitude report in Tiwa, rather than a simple embedded CP, carries semantic consequences: while classic *de re* readings of the proleptic object are possible, classic *de dicto* readings are impossible. In this section, we will provide evidence for this, and propose a compositional analysis that captures these facts.

3.1. Classic *de re* readings are available

We show in (30)-(32) that prolepsis is felicitous in contexts that support classic *de re* readings. In (30), Mukton holds a belief about a particular baby leopard, and the NP predicate *shônggadi pisá* 'baby leopard' is interpreted with respect to the world of evaluation, not with respect to Mukton's doxastic alternatives (Mukton does not believe the baby leopard is a leopard).

(30) Context: One man in Shiktamakhâ has a baby leopard as a pet. It is very small still, and Mukton thinks it is a cat, not a leopard.

Mukton **pe shônggadi pisá-gô**$_i$ atkhâl lá-ga, [*pro*$_i$ miyâw hóng-do honmandé.]
Mukton that leopard DIM-ACC think-PFV 3SG cat COP-IPFV COMP
'Mukton thinks that baby leopard is a cat.'[8]

In (31), the attitude holder also holds a belief of a particular individual, in this case the dog that he saw approaching his food. In this example, the proleptic object is visibly quantificational, scoping above the attitude verb, and *khúgri* 'dog' is readily interpreted with respect to the actual world (seeing as the context provides for no differences between what is actually a dog and what is a dog in Mukton's doxastic alternatives).

(31) Context: There is a gathering outside with a lot of food on different tables. People are there with their families and many dogs are there. Mukton leaves his rice on one table and then he sees a dog come up to it. He looks away, and when he looks back, the rice is gone.

Mukton$_j$ **kishá khúgri-gô**$_i$ atkhâl lá-ga, [*pro*$_i$ pe-ne$_j$ mai-go chá-ga
Mukton one dog-ACC think-PFV 3SG 3SG-GEN rice-ACC eat-PFV
honmandé.]
COMP
'Mukton thinks a dog ate his rice.'

(32) provides an example of mistaken identity with a referential proleptic object. In this example, the attitude holder Tonbor holds a belief about a particular woman he saw. Unbeknownst to him, the woman he holds the attitude about is in fact the speaker's sister Rachel.

(32) Context: We have been waiting for my sister Rachel to come and visit us in Umswai. Tonbor doesn't know I have a sister, but he saw a foreign woman in Nellie getting in a sumo (=jeep). He thinks that that foreigner must be coming to Umswai, and he told us so.

Tonbor **Rachel-go**$_i$ atkhâl lái-do, [táw *pro*$_i$ Umswai-jíng phi-w honmandé.]
Tonbor Rachel-ACC think-IPFV today 3SG Umswai-ALL come-NEUT COMP
'Tonbor thinks that Rachel is coming to Umswai today.'

These data show that prolepsis in Tiwa supports classic *de re* readings.

3.2. Classic *de dicto* readings are not available

In contrast, proleptic objects in Tiwa cannot receive a classic *de dicto* interpretation. This is illustrated in (33)-(35). In (33), the attitude holder mistakenly believes that the speaker has a brother and that he is helping her unload boxes. Because the speaker does not have a brother in the actual world, the proleptic object cannot be interpreted with respect to the actual world, but only the attitude holder's doxastic alternatives. The infelicity of this example shows that this option is unavailable for a proleptic object; opaque interpretation (in the sense of Fodor, 1970) is ruled out. Note that a simple embedded CP without prolepsis is possible in this scenario.

[8]Note: *miyâw* strictly refers to domesticated cats, and does not encompass wild cats such as leopards.

(33) Context: I have to unload a lot of heavy boxes, so my neighbor comes and helps me. Someone who's new to the village sees him helping me, and she thinks he must be my older brother. Actually, though, I don't have an older brother.

#Ái khái cha, thêbo pe margî **ái khái-gô**$_i$ atkhâl lái-do, [*pro*$_i$
my brother exist.NEG but that woman my brother-ACC think-IPFV 3SG
ang-gó ráp os-ga honmandé.]
1SG-ACC help AUX-PFV COMP
'I don't have a brother, but that woman thinks my brother is helping me.'

Example (34) makes a similar point. There are no such things as winged cows, and therefore any felicitous reading must allow for an opaque interpretation of *kráng tonga masú* 'winged cow'. In a proleptic structure, no such reading is possible. Again, note that a plain embedded CP is felicitous in this context.

(34) Context: Mansing is a bit crazy.

#*pro*$_j$ **kráng tonga masú-gô**$_i$ atkhâl lá-ga, [*pro*$_i$ payâr-o thái-do honmandé,]
3SG wing having cow-ACC think-PFV 3SG outside-LOC stay-IPFV COMP
(thêbo kráng tonga masú cha.)
but wing having cow exist.NEG
'He thinks there's a winged cow outside, (but winged cows do not exist.)'
Speaker comment: "Means definitely there is one."

Likewise, the non-existence of actual green dogs makes (35) infelicitous. Proleptic objects cannot be interpreted solely with respect to the attitude holder's doxastic alternatives.

(35) Context: Tonbor is not very smart. He doesn't know that dogs can't be green.

#Tonbor **kishá khódang shór khúgri-gô**$_i$ atkhâl lá-ga, [Lastoi *pro*$_i$ pre-ga
Tonbor one green dog-ACC think-PFV Lastoi 3SG buy-PFV
honmandé.]
COMP
'Tonbor thinks that Lastoi bought a green dog.'

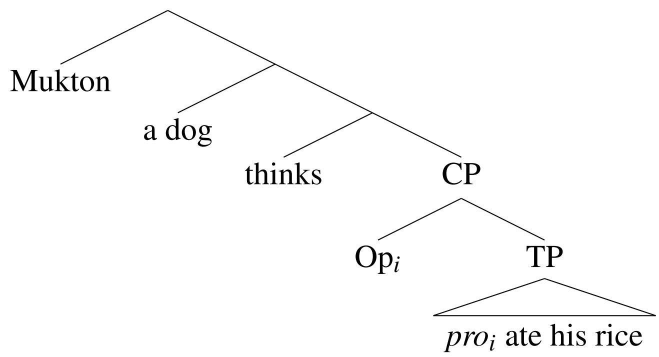
We conclude that proleptic structures require an existential commitment regarding the NP predicate at the world of matrix evaluation.

3.3. Analysis: verb-mediated *de re*

We now turn to a compositional account of these findings. Drawing on Salzmann (2017b) and Deal (2018), we propose the basic structure for prolepsis in (36), illustrated here for example (31) above. In keeping with the results of the previous section, the proleptic object is base-generated in the matrix clause, and the embedded clause contains a pronoun. We assume that this pronoun is semantically bound by a base-generated clause-edge abstractor (cp. Chierchia, 1989), and as such, the embedded CP contributes an intensional property rather than a proposition.[9]

[9]Our assumption of a base-generated clause-edge abstractor can be contrasted with a proposal from Salzmann (2017b), according to which the embedded pronoun itself moves to the edge of the CP and thereby creates an

(36)



The attitude verb mediates the composition of the intensional property argument provided by the CP with the matrix object (i.e., the *res*). Our proposal for the denotation of *atkhâl lá* 'think' in (31) is given in (37).

(37) $[\![$atkhâl lá 'think'$]\!]$ = $\lambda P_{\langle e,st\rangle}.\lambda x.\lambda y.\lambda w.\forall w' \in$ DOX(y,w)[P(x)(w')=1]

For (31), starting from the syntactic structure in (36), the quantificational object QRs, yielding the desired truth conditions, shown in (38): there is a particular, evaluation-world dog that Mukton believes ate the rice.

(38) $\lambda w.\exists x[x$ is a dog in w & $\forall w' \in$ DOX(Mukton,w)[x ate the rice in w']]

This analysis of course can be straightforwardly adapted to account for cases of "double vision", as in example (32) above, by making reference to acquaintance relations/modes of presentation, as in (39) (Kaplan, 1968; Lewis, 1979; cp. Heim, 1994; Deal, 2018). We dub this the Kaplan-Lewis variant:

(39) $[\![$atkhâl lá 'think'$]\!]$ = $\lambda P_{\langle e,st\rangle}.\lambda x.\lambda y.\lambda w.$ R(w)=x & R is suitable for y in w & $\forall w' \in$ DOX(y,w)[P(R(w'))(w') = 1] (Kaplan-Lewis variant)

Both versions of this denotation retain the same argument structure and the same inability to support *de dicto* readings. In particular, in neither case can the NP restrictor of the proleptic object have its world variable bound by the attitude verb. This explains why the proleptic structure enforces existential commitment regarding this NP description.

4. Third readings

We turn now to the question of third readings. Prolepsis in German and in Nez Perce does not allow third readings (Salzmann, 2017b:307; Deal, 2018); only classic *de re* readings are permitted. We show in this section that the Tiwa facts are different: proleptic structures support third readings in this language.[10]

abstraction. Salzmann motivates this movement on the basis of the island behavior of proleptic CP complements in German. In Tiwa, however, (like in Nez Perce; see Deal, 2018) the proleptic CP is not an island environment, as shown in (i) for long-distance scrambling.

(i) 'Saldi thinks that Lastoi gave flowers to Mukton.'

a. Saldi **Lastoi-go**$_i$ atkhâl lá-ga, [*pro$_i$* Mukton-a khum os-ga honmandé.]
Saldi Lastoi-ACC think-PFV 3SG Mukton-DAT flower give-PFV COMP

b. Mukton-a$_j$, Saldi **Lastoi-go**$_i$ atkhâl lá-ga, [*pro$_i$* t_j khum os-ga honmandé.]
Mukton-DAT Saldi Lastoi-ACC think-PFV 3SG flower give-PFV COMP

[10]We find these results particularly striking in view of the fact that the very same types of scenarios used in investigating third readings in Nez Perce yielded different results in Tiwa. Compare example (40) to example (26)

First consider (40), partially repeated from the introduction. (40a) sets up the context: the attitude holder Mukton is afraid to go outside. (40b) contains the crucial proleptic example. Mukton does not want to go outside because he believes he will be bitten by a mosquito if he does.

(40) a. Mukton$_j$ payâr-jíng lí-na mon cha.
Mukton outside-ALL go-INF desire NEG
'Mukton does not want to go outside.'

b. *pro*$_j$ **kishá khódo-gô**$_i$ atkhâl lá-ga, [*pro*$_i$ pe-go$_j$ chi-w honmandé.]
3SG one mosquito-ACC think-PFV 3SG 3SG-ACC bite-NEUT COMP
'He thinks a mosquito will bite him.'

Given our world knowledge of how people relate to mosquitos, this is a third reading: there is no particular, individual mosquito that Mukton thinks will bite him. The quantificational force of *kishá khódo* 'a mosquito' scopes beneath the attitude verb. At the same time, however, an utterance of (40b) does make a commitment to the existence of mosquitos in the actual world. Tiwa speakers report that this example becomes infelicitous in a scenario in which the government has devised a way to eradicate all mosquitos.

(41) provides another example. Here, the attitude holder Lastoi is scared because one of the twins (Sonali and Saldi) she is babysitting is missing. Lastoi does not know which twin it is. That is, she does not hold a belief about any particular individual: she does not believe Sonali is missing, and she does not believe Saldi is missing. Thus the quantificational force of the proleptic object *sáninge majo sája korkhyágô* 'one of the two children' is scoping beneath the attitude verb. Note that here again, just like in the mosquito example, there is existential commitment regarding the NP predicate.

(41) Context: Lastoi looks after a pair of identical twins, Sonali and Saldi, for her friend. They look the same and they dress the same and Lastoi can't tell them apart. One day, one of the twins decides to play a mean trick on Lastoi and hides under the bed instead of playing in the garden. Lastoi gets frightened because she thinks one of the twins is missing, but she can't tell which one.

Lastoi$_j$ khén-do. Pe$_j$ **sáning-e majo sája korkhyá-gô**$_i$ atkhâl lái-do, [*pro*$_i$
Lastoi fear-IPFV 3SG two-GEN midst one child-ACC think-IPFV 3SG
kumái lí-ga honmandé]
disappear AUX-PFV COMP
'Lastoi is scared. She thinks that from among the two a child has disappeared.'

Example (42) makes a similar point. Here, the speaker and Lastoi were speculating how some jackfruits disappeared. Lastoi thinks that a monkey might have stolen them, but does not think this of any monkey in particular.

in Deal (2018) and example (41) to example (24) in Deal (2018).

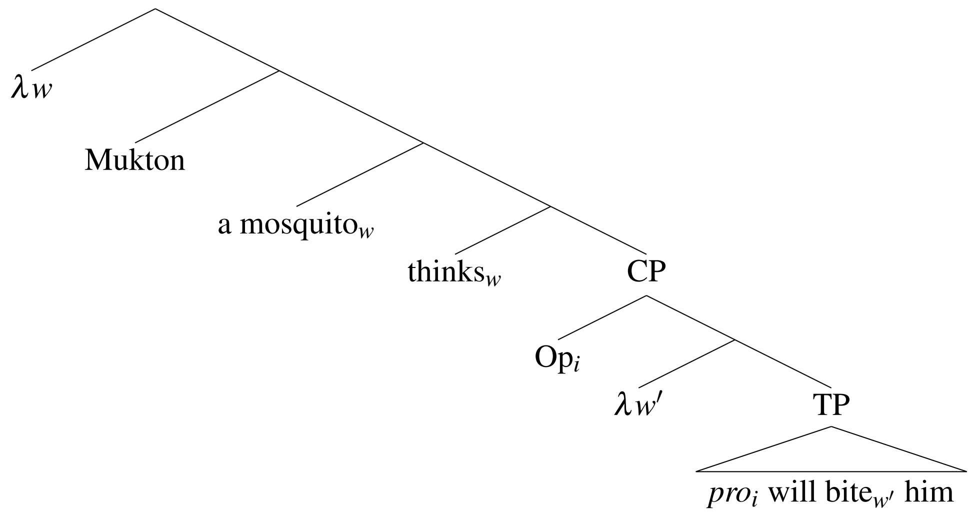
(42) I left some jackfruits outside my house and the next morning they were gone. We're guessing about what happened to them.
Lastoi **kishá makhrí-gô**$_i$ atkhâl lá-ga, [*pro*$_i$ khândal-go chá-ga honmandé.]
Lastoi one monkey-ACC think-PFV 3SG jackfruit-ACC eat-PFV COMP
'Lastoi thinks a monkey ate the jackfruits.'
Confirmed: Lastoi thinks it could be any monkey.

These examples show that third readings of proleptic objects are possible in Tiwa: the quantificational force of the DP can scope beneath the attitude verb, but the NP description must be interpreted with respect to the matrix evaluation world (ruling out the classic *de dicto* scenarios in §3.2).

4.1. Analysis: Semantic scope lowering

A compositional analysis of third readings in proleptic structures begins with the basic fact that there is no evidence of any syntactic difference vis-à-vis the classic *de re* interpretation. Therefore, we work with the null hypothesis that the structures are the same: the proleptic object is base-generated in the matrix clause, and the embedded clause contains an operator that binds a pronoun. (Recall that the Condition A data from §2.1 provide evidence that there is **no** movement derivation, only prolepsis.) However, for a clear picture of third readings it will prove especially useful to graphically represent information about the world-interpretation of particular predicates, and as such we augment our previous type of structures with world arguments and binders thereof. An example structure is given in (43) for example (40).[11]

(43)



To derive third readings, we need to get the quantificational force of the object to scope beneath the attitude verb, without causing the NP restrictor to be evaluated only with respect to the attitude holder's doxastic alternatives. This, we note, is closely parallel to the semantic reconstruction suggestion from von Fintel and Heim (2011) shown in (2). The difference is that the quantifier in (43), unlike (2), is base-generated in a high position. Thus our analysis will appeal not to reconstruction *sensu stricto* (understood as a phenomenon applying only in

[11]Note that our representation of syntactic world variables and binders is for exposition only. Our overall proposal involves only locally bound world pronouns, and as such is easily translated to a more traditional system without world variables in the syntax.

contexts of movement) but rather to a more general strategy of *semantic scope lowering*. To accomplish this, we propose an additional denotation for the attitude verb, as in (44), which exists alongside the classic *de re* version in (37) above. Here the CP again contributes an intensional property as the first argument to the predicate.[12] The second argument, however, is not an individual, but a quantifier:

(44) ⟦atkhâl lá 'think'⟧ (version 2)
$=\lambda P_{\langle e,st\rangle}.\lambda Q_{\langle et,t\rangle}.\lambda y.\lambda w.\forall w' \in \text{DOX}(y,w)[Q(\lambda x.P(x)(w'))=1]$

Given the GQ type argument position provided by the predicate, the quantificational proleptic object composes *in situ* with the verb. A partial computation of the semantic value of (43) is given in (45).

(45) Computation for (43)
a. ⟦CP⟧ = λx.λw. x will bite M in w
b. ⟦thinks CP⟧ = $\lambda Q_{\langle et,t\rangle}.\lambda y.\lambda w.\forall w' \in$ DOX(y,w)[Q(λx.x will bite M in w')=1]
c. ⟦a mosquito$_w$ [thinks CP]⟧ = $\lambda y.\lambda w.\forall w' \in$ DOX(y,w)[$\exists$x[x is a mosquito in w & x will bite M in w']]

Note that this higher type version of 'think' still (correctly) does not allow for classic *de dicto* readings of the matrix object: because the NP restrictor is interpreted in the matrix clause, it is evaluated with respect to the matrix world of evaluation. Only the quantificational force of the matrix object is lowered.

This analysis makes a prediction regarding the scopal possibilities of the proleptic object inside the embedded CP. Namely, the verb denotation in (44) predicts that the proleptic object should scope immediately under the attitude verb, but above any operators internal to the embedded CP. At present we do not have Tiwa data to test this prediction. However, we observe that the general strategy of semantic scope lowering can be slightly modified to alternatively capture a system in which the proleptic object shows variable scope in the embedded clause (should this be the pattern borne out by the facts). On this alternative, the bound pronoun in the embedded clause (and its binding operator on the clause edge) is of generalized quantifier type, as in (46):

(46) ⟦atkhâl lá 'think'⟧ (version 2 alternative: variable scope)
$=\lambda P_{\langle\langle et,t\rangle,st\rangle}.\lambda Q_{\langle et,t\rangle}.\lambda y.\lambda w.\forall w' \in \text{DOX}(y,w)[P(Q)(w')=1]$

Given that it is a generalized quantifier, the bound pronoun should be able to show the full range of scope possibilities available clause-internally to GQ items in Tiwa.

One potential upshot of this second approach to third readings in prolepsis contexts is a deepened connection between prolepsis and semantic reconstruction. After all, the treatment of the bound pronoun as a quantifier in (46) is exactly parallel to the treatment of the trace in the semantic reconstruction example in (2). Could we then draw a link between the possibility of third readings in prolepsis and the possibility of semantic reconstruction? Not perfectly: German, for instance, does not allow third readings in prolepsis (Salzmann, 2017b), and yet does allow semantic reconstruction (Lechner, 1998). It may still be that the implication works in one direction: if a language generally allows GQ type pronouns, then that language must also allow semantic reconstruction. The testing of this hypothesis of course depends on the

[12]Thanks to Ezra Keshet for encouraging us to think along these lines.

identification of further languages with evidence for GQ type pronouns, as well as languages without semantic reconstruction.

As a final note, just as our initial verb denotation in (37) can be straightforwardly updated to accommodate acquaintance relations/modes of presentation, so too these two higher-typed verb denotations can be modified to yield Kaplan/Lewis variants. To do so we require acquaintance/modes of presentation of quantifiers (cp. Cresswell and von Stechow, 1982, Schwager, 2010 on *res* expressions that are not individuals).

(47) $[\![$atkhâl lá 'think'$]\!]$ $=\lambda P_{\langle e,st\rangle}.\lambda Q_{\langle et,t\rangle}.\lambda y.\lambda w.R(w)=Q$ & R is suitable for y in w & $\forall w' \in DOX(y,w)[R(w')(\lambda x.P(x)(w'))=1]$ (Kaplan-Lewis variant, fixed scope)

(48) $[\![$atkhâl lá 'think'$]\!]$ $= \lambda P_{\langle\langle et,t\rangle,st\rangle}.\lambda Q_{\langle et,t\rangle}.\lambda y.\lambda w.$ R(w)=Q & R is suitable for y in w & $\forall w' \in DOX(y,w)[P(R(w'))(w')=1]$ (Kaplan-Lewis variant, variable scope)

4.2. Remarks on ambiguity

Our proposal for the meaning of attitude reports in Tiwa has explicitly featured two distinct denotations for the verb 'think', one which produces classic *de re* readings (viz. (37), with Kaplan/Lewis variant (39)) and one which produces third readings (viz. (44) or (46),with Kaplan/Lewis variants (47) and (48) respectively). In addition, we also note the necessity of postulating a third denotation for 'think' in Tiwa – perhaps the crosslingustically least marked such denotation – in virtue of purely *de dicto* reports with no prolepsis structure (compare with (34) above):

(49) Context: Mansing is a bit crazy.

Mansing atkhâl lá-ga, [kráng tonga masú payâr-o thái-do honmandé.]
Mansing think-PFV wing having cow outside-LOC stay-IPFV COMP
'Mansing thinks there's a winged cow outside.'

We close this section with a remark about the nature of this ambiguity.

Salzmann (2017a) notes that one point of cross-linguistic variation in prolepsis concerns the productivity of the construction across a range of verbs. It is available for a range of verbs in German, as he shows; however, it is quite limited in Nez Perce (where it is possible only with verbs meaning 'think' and 'know'; Deal, 2018). Given the absence of productivity in Nez Perce, Deal (2018) declines to postulate any sort of semantic rule that might map between a *de dicto* denotation for 'think' (used in non-proleptic structures) and a *de re* version that is used in prolepsis. The two lexical entries for 'think' and 'know' simply are listed side-by-side in the Nez Perce lexicon.

This sort of approach is clearly less attractive for a language in which prolepsis is highly productive, and Tiwa turns out to be a language of this type. Prolepsis in Tiwa is very productive across a range of verbs, including those listed in (4) above. For instance, a proleptic structure (in addition to a simple embedded CP) is available for the verb *hon* 'say', as shown in (50)-(51).

(50) Saldi Tonbor-a **Mansing-go**$_i$ hon-ga, [*pro*$_i$ Lastoi-go nú-ga honmandé.]
Saldi Tonbor-DAT Mansing-ACC say-PFV 3SG Lastoi-ACC see-PFV COMP
'Saldi said to Tonbor that Mansing saw Lastoi.'

(51) Context: Sonali is talking with Saldi about Mansing. She told Saldi that Mansing left.

Sonali **Mansing-go**$_i$ hon-ga, [*pro*$_i$ lí-ga honmandé.]
Sonali Mansing-ACC say-PFV 3SG go-PFV COMP
'Sonali said that Mansing went.'

As far as we are aware, the range of possible interpretations for proleptic structures remains the same regardless of the particular verb chosen. For example, both third readings and classic *de re* readings (but not opaque, *de dicto* readings) are available for *si-* 'know'.

(52) Context: You, me, and Sonali are playing a game with Mukton. We each tell him a funny story, but only one of the stories is true and the other two are made up. Mukton has to guess which person is telling the truth. We tell Mukton the stories, but he has no idea who is telling the truth and who is lying.

Mukton$_j$ **ching-e majo sáning-gô**$_i$ si-ga, [*pro*$_i$ thâdok rí-ga honmandé,]
Mukton 1PL-GEN midst two-ACC know-PFV 3PL lie do-PFV COMP
thêbo shar pe$_j$ si-ya.
but who 3SG know-NEG
'Mukton knows that two of us are lying, but he doesn't know who.'

(53) Context (after (52)): We tell Mukton the stories again, to give him another chance. This time Sonali and me can't stop laughing as we tell our stories, so he knows that it is us who are lying, and you are telling the truth.

Mukton$_j$ **ching-e majo sáning-gô**$_i$ si-ga, [*pro*$_i$ thâdok rí-ga honmandé.]
Mukton 1PL-GEN midst two-ACC know-PFV 3PL lie do-PFV COMP
'Mukton knows that two of us are lying.'

Accordingly, we propose that the three-way ambiguity of attitude verbs in Tiwa arises via lexical rules which lift basic attitude predicate denotations as in (54) (where ACC is a modal accessibility/alternativeness relation, determined by the individual verb) to the denotations found in cases of prolepsis. A first such lifting rule produces the classic *de re* reading discussed in section 3:

(54) Basic (non-proleptic) denotation
$\lambda p_{\langle st \rangle}.\lambda y.\lambda w.\forall w' \in ACC(y,w)\ [p(w')=1]$

(55) $LIFT_{\alpha}$ (to proleptic classic *de re* version)
$\lambda \mathcal{P}_{\langle st,\langle e,st \rangle\rangle}.\lambda R_{\langle e,st \rangle}.\lambda x.\lambda y.\lambda w.\mathcal{P}(\lambda w'.R(x)(w')=1)(y)(w)=1$

For the third reading, the particular rule required depends on the scopal possibilities of the quantifier with respect to embedded material. We take as a null hypothesis the more restricted version (44), associated with the lift in (56a). Evidence for the less restricted version, (46), would lead us instead to postulate lift (56b).

(56) a. $LIFT_{\beta_1}$ (to proleptic third reading version (44))
$\lambda \mathcal{P}_{\langle st,\langle e,st \rangle\rangle}.\lambda R_{\langle e,st \rangle}.\lambda Z_{\langle et,t \rangle}.\lambda y.\lambda w.\mathcal{P}(\lambda w'.Z(\lambda x.R(x)(w')=1))(y)(w)=1$
b. $LIFT_{\beta_2}$ (to proleptic third reading version (46))
$\lambda \mathcal{P}_{\langle st,\langle e,st \rangle\rangle}.\lambda \mathcal{R}_{\langle\langle et,t \rangle,st \rangle}.\lambda Z_{\langle et,t \rangle}.\lambda y.\lambda w.\mathcal{P}(\lambda w'.\mathcal{R}(Z)(w')=1)(y)(w)=1$

A plausible hypothesis is that the existence of such rules, and choice among them, constitutes a semantic parameter. German, for instance, makes use of LIFT_α but not LIFT_β, resulting in productive classic *de re* readings in prolepsis, but no third readings. Tiwa's use of both LIFT_α and LIFT_β makes both types of readings productively available. In Nez Perce, where prolepsis is not productive across verbs, it may be that no such rules at all are in force. It remains to be seen whether prolepsis in any language calls for LIFT_β but not LIFT_α, the reverse of the German pattern; in such a language we would expect prolepsis to be productive across verbs but to allow only third readings, not classic *de re*.

5. Conclusion

One overall conclusion from this study is that semantic scope lowering is a possible route to third readings, required in at least some cases (e.g. Tiwa prolepsis). Third readings, that is, arise not only due to manipulations of the NP restrictor of an embedded quantifier. A potentially important observation about the Tiwa data is that while quantifiers can be interpreted lower than their surface position, world arguments cannot. This restriction is reflected in our analyses in (44) and (46). In particular, on analysis (46), the world argument cannot be bound by the attitude verb because the pronoun is not intensional. If this analysis is on the right track, it may ultimately lend support to a generalization that semantic scope lowering is universally restricted to binding of $\langle et,t\rangle$ traces/pronouns, rather than intensionalized versions thereof.

Several parts of this analysis lead to new prospects for semantic universals and variation in the interpretation of proleptic structures. For instance, it may be that third readings under prolepsis correlate with semantic reconstruction possibilities across languages, as might be expected on analysis (46). An alternative possibility is that the availability of third readings under prolepsis simply reflects choices about lexical lifting rules of the type in (55) and (56). Our formulation of these rules reflects a suspicion that classic *de re* and third reading options in prolepsis may be independent of one another; that is, it may be that there are languages which have either one but not the other. Given the range of languages for which prolepsis analyses have been proposed (Higgins, 1981; Ingria, 1981; Saito, 1983; Takano, 2003; Davies, 2005; Salzmann, 2017a, b), we are hopeful that future work will be able to more fully ascertain which of these possibilities is correct.

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Vague predicates, crisp judgments[1]

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Abstract. Nez Perce is a language with a dedicated comparative morpheme and crisp judgments in its comparatives, but with no means to express differential measurement in its comparative. These data can be captured by two different types of analyses: either Nez Perce has a negative setting of the Degree Semantics Parameter ([±DSP]) (Beck et al., 2009), along with a comparative operator that allows manipulation of context (Klein, 1980), or it has a positive setting of said parameter, but the comparative operator does not provide a slot for a differential degree argument. We show that the "degreeless" analysis of gradable adjectives in Nez Perce provides a unified and simple explanation for a cluster of additional properties of the language. At the same time, our findings draw attention to hitherto unattested variation within degreeless languages: other [-DSP] languages like Motu (Beck et al., 2009), Washo (Bochnak, 2015) and Warlpiri (Bowler, 2016) lack the Klein-style comparative operator present in Nez Perce.

Keywords: degree, vagueness, comparison, delineation semantics, semantic variation, semantic fieldwork, Degree Semantics Parameter, Nez Perce.

1. Introduction: "degreeless languages" and vague predicates

Recent work on semantic variation in comparison constructions has uncovered significant cross-linguistic differences not just in how languages convey comparison, but in what types of comparisons languages make it straightforward – or even possible – for their speakers to talk about. Most notably, in the course of his thorough study of gradable predicates and comparison in Washo, Bochnak (2015) demonstrates that Washo not only lacks any dedicated linguistic means of expressing comparatives, superlatives, measure phrases, and degree adverbs, but it also makes it difficult to express comparisons between individuals that are very close to one another in terms of the dimension or quantity being measured. In order to compare individuals in Washo, given the absence of any comparative morphology, speakers must use a juxtaposed opposition, what Stassen (1985) dubbed a "conjoined comparative":

(1) *wíːdiʔ ʔitmáŋa de-l-káykay-iʔ k'-éʔ-i wíːdiʔ*
this ladder NMLZ-ATTR-tall-ATTR 3-COP-IPFV this
de-l-káykay-iʔ-éːs k'-áʔ-a-š
NMLZ-ATTR-tall-ATTR-NEG 3-COP-AOR-SR
lit. 'This ladder is tall, that one is not tall.' (Bochnak, 2015: p. 12)

Sentence (1), Bochnak reports, is inappropriate in cases where the two items to be compared are very close in height; speakers must use a hedge (e.g. "almost big"). Furthermore, it is entirely impossible in Washo to explicitly express the extent of difference between two individuals, along the lines of the English differential comparative in (2):

(2) *Vera is exactly 7 centimeters taller than AR.*

[1]We would like to gratefully acknowledge Nez Perce teachers Bessie Scott and Florene Davis for sharing their knowledge of Nez Perce. Thanks as well go to audience members at SULA, at SuB, in Tübingen, and in Göttingen, and members of the Research Group in Formal Semantics at UC Berkeley for helpful commentary.

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Bochnak argues that these difficulties in the expression of crisp judgments (i.e. comparison between two dimensionally similar entities) and differential comparatives trace back to a core linguistic difference between Washo and English in terms of the semantics of gradable predicates. In particular, Washo gradable predicates and their English translations differ in their argument structure, where the English versions but not their Washo counterparts involve degree arguments. This type of cross-linguistic variation was initially posited by Beck et al. (2009) as the *Degree Semantics Parameter* (DSP).

(3) $[\![\, tall_{\text{Washo}}]\!]^c = \lambda x.x$ counts as tall with respect to context c

(4) $[\![\, tall_{\text{English}}]\!]^c = \lambda d.\lambda x.x$ is d-tall

(5) DEGREE SEMANTICS PARAMETER [$\pm$ DSP] (Beck et al., 2009: p. 19):
A language {does/ does not} have gradable predicates (type $\langle d, \langle e,t \rangle\rangle$ and related), i.e. lexical items that introduce degree arguments.

We will call predicates analyzed in the style of (3) *vague predicates*. In this paper we begin with the observation that the vague predicate analysis (or alternatively, a negative setting on the DSP) is not, by itself, sufficient to explain the absence of comparative morphology in Washo, and the need for hedges in crisp judgment contexts. It is perfectly possible to provide a meaning for comparative morphology that supports crisp judgments and that does not make reference to degree arguments as in (4); this, after all, is exactly the proposal from Klein (1980, 1982). On Klein's analysis, the English comparative morpheme in (6) manipulates the contextual value with respect to which tallness is determined:

(6) $[\![\, \textit{Vera is taller than AR}]\!]^c = 1$ iff there is a context c' such that Vera counts as tall with respect to c' and AR does not count as tall with respect to c'

A hypothetical language with degreeless adjectives and a Klein-style comparative would be one with *vague predicates but crisp judgments*. In any context containing individuals A and B, if A and B are different in height, there will be a way of assigning one but not the other to the positive extension of the predicate *tall*. (For Klein, this involves manipulating the comparison class provided by the context; see Klein, 1980: §3). Thus, we expect a crisp judgment. By the fact that Washo requires the conjunctive strategy for comparisons, and requires hedges in crisp judgment contexts, we should conclude not only that its adjectives have vague denotations of the style in (3), but also that it lacks a Klein-style comparative morpheme in its functional inventory. In other words, if we describe only the semantics of open class gradable predicates in the language, we fail to capture the complete set of facts that makes Washo so interestingly different from English in what it makes it easy for its speakers to express.

We might ask whether the same situation obtains for the case of differential comparatives, e.g. (2), which Washo makes it entirely impossible to express. Here things are rather different. Differentials, as von Stechow (1984) observed, require something more than the partitioning of entities into two groups, assigning one but not the other to the positive extension of the gradable predicate. We need a notion of measurement which can support addition. If indeed (as argued by Beck et al., 2009 and Bochnak, 2015) there are some languages that make use of degrees in the semantics of their gradable predicates, and others that do not, this richer notion is surely diagnostic of the former class: degrees form scales that support addition automatically, whereas degreeless, vague predicates do not. Thus the existence of differential comparatives in English leads von Stechow (1984) to reject Klein's degreeless proposal.[2] For the case of Washo, the adoption of a vague predicate analysis for gradable predicates automatically delivers the absence of differential comparatives. Nothing further about the lexicon need be stipulated.

These considerations raise the question of whether we might find language types intermediate between Washo and English with regards to crisp judgment and differential comparative behavior – in particular, languages with comparatives supporting crisp judgments, but without differential comparatives. In principle, two such language types might be expected. One type are [-DSP] languages with a Klein-style comparative operator, as discussed above. Given the semantics for the operator, we expect crisp judgments; given the [-DSP] status, we expect the absence of differential comparatives. The second type are [+DSP] languages with comparative morphology that manipulates degrees, but lacking the particular functional morphology necessary for the expression of the differential comparative. In including this second language type in our discussion here, we note (in parallel to the case of Washo with which we began) that the [+DSP] status of a language like English is not enough to guarantee its ability to express differential comparatives. Differential comparatives require a certain type of comparative operator – functional morphology that may in principle be missing from the functional lexicon of a language even if that language has degreeful gradable predicates.[3] In other words, the implication from differential comparatives to DSP status only works for one polarity: the presence of differential comparatives implies [+DSP] status, but the absence of differential comparatives is compatible with either positive or negative DSP settings.

In the rest of this paper we first introduce an existence proof for languages of this overall intermediate kind. Our evidence comes from Nez Perce (Sahaptian; USA), a language with a dedicated comparative morpheme and crisp judgments in its comparatives but with no means to express differential comparatives of any type. In the second part of the paper, we work to locate the Nez Perce system with respect to the two potential language types described just above by reviewing the evidence for or against degree arguments in gradable predicates independent of the simplex comparison construction. We conclude that a [-DSP] analysis provides the simplest and most unified coverage of a suite of facts concerning measure phrases, degree questions, and "comparison with a degree" in Nez Perce – a line of reasoning parallel to Bochnak's (2015).[4] The end result highlights the internal diversity of [-DSP] languages as well as the variable ways in which we may or may not wish to describe natural languages as "degreeless".

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[2]One notable response to this rejection lies in the development of a richer notion of scale structure for vague predicates that allows addition to be defined without explicit reference to degrees. This is the project of the measurement theorists (Sassoon, 2010, 2013; van Rooij, 2011), who in turn may reject the core hypothesis of cross-linguistic variation encoded by the DSP in favor of an argument-structurally uniform analysis of gradable predicates in natural language. See Bochnak (2015) for discussion.

[3]We assume that ordinary degree-based comparative operators do not always contain an argument slot for a differential (which is perhaps subject to existential closure); a special comparative operator is required for differentials. This point is perhaps clearest when we consider both additive and multiplicative differentials (ratio phrases), e.g. *Vera is 2 cm taller than AR* and *Vera is three times taller than her cousin*; these differentials require different operators in order to ensure addition in one case but not the other. See also Nee (2018) for some morphological evidence from a Zapotec language that differentials require special comparative operators.

[4]Our reasoning is also mostly parallel to Beck et al.'s (2009), with the exception of how we treat "comparison with a degree". As discussed below, we do not take such constructions as automatic evidence for a [+DSP] analysis, and suggest a [-DSP]-compatible approach to them.

2. Comparison in Nez Perce

Nez Perce is a highly endangered Sahaptian language spoken in Idaho, Washington, and Oregon, USA. The data in this paper come from the first author's fieldwork with two speakers, Bessie Scott and Florene Davis, on the Nez Perce Reservation in Lapwai, Idaho, primarily in 2016-2018. Descriptions of various aspects of Nez Perce grammar may be found in Aoki (1970, 1994), Rude (1985 *et seq.*), Crook (1999), and Deal (2010 *et seq.*). To our knowledge, this is the first in-depth description or analysis of comparatives in the language.

Nez Perce has distinct lexical classes of verbs, nouns, adjectives, and quantifiers/numerals (Deal, 2015, 2016). Only verbs bear inflection for tense, aspect, and mood; verbs also show a distinctive system of person and number agreement with their arguments. Quantifiers/numerals can be identified by their distinct morphological reflections of the [±HUMAN] distinction. (Note that Nez Perce lacks articles.) Nouns and adjectives, while subject to numerous morphological similarities, can be distinguished by their patterns of inflection as well: nouns in the [-ANIMATE] class are incapable of bearing plural inflection, but adjectives modifying such nouns do inflect for plurality. Adjectival predication features an obligatory copula, and usually S V A order (though there is some order flexibility, as in Nez Perce in general; see Rude, 1992). Attributive adjectives are reliably prenominal.

(7) a. *Calvin hii-wes tisqa'aw*
Calvin.NOM 3SUBJ-be.PRES fat
'Calvin is fat.'

b. *himeeq'is picpic*
big cat
'a/ the big cat'

In the rest of this section we first turn to the structures used for comparison with adjectives in Nez Perce, and then to key aspects of these structures' interpretation.

2.1. Morphosyntactic properties

Comparatives may be formed both from predicative and attributive adjectives in Nez Perce. The standard of comparison is marked either by *-(p)x* 'to' or *-(p)kin'ix* 'from';[5] we have not observed any grammatical or semantic differences between these two forms. Predicative comparisons are shown in (8)-(9). Note the presence of the comparative word *qetu* 'more' right before the adjective.

(8) *Pit'iin' hii-wes qetu kuhet* [*ko-nim-x 'aayato-px*]$_{\text{standard}}$
girl.NOM 3SUBJ-be.PRES MORE tall [that-OBL-to woman-to]
'The girl is taller than that woman.'

(9) *Kareem hii-wes qetu kuhet* [*Shaq-kin'ix*]$_{\text{standard}}$
Kareem.NOM 3SUBJ-be.PRES MORE tall [Shaq-from]
'Kareem is taller than Shaq.'

[5] These elements show a mix of case-like and P-like behavior. They are case-like in showing concord across the DP, as in (8). (Also attested is a pattern in which these elements attach only to one element of the standard phrase, often the first word; see (13).) They are P-like in assigning oblique case to their sisters, as in (20); note that oblique case is visible (non-syncretic with nominative) only on pronouns and demonstratives. We will take standard phrases to be PPs, leaving it open whether *-(p)x* and *-(p)kin'ix* realize a P head, a case assigned by such a head, or some mix.

Attributive comparison is shown in (10); note again the word *qetu* right before the adjective.

(10) *Meeli hi-'nip-e qetu himeeq'is 'atoc* [*John-nim-kin'ix 'atoc*]$_{\text{standard}}$
Mary.NOM 3SUBJ-buy-TAM MORE big car John-GEN-from car
'Mary bought a bigger car than John's car.'

Given that the standard morphology is case/P-like, we might expect Nez Perce to have only phrasal comparatives (Bhatt and Takahashi, 2011). This expectation receives support from the fact that clause-like standards are never attested, and attempts to form clause-like standards (e.g., for the expression of a subcomparative) are rejected.

Many languages with dedicated comparative morphology treat that morphology as optional; that is, the comparative word may be present or absent, while preserving the overall sentence meaning (e.g. Hindi, Bhatt and Takahashi, 2011; Samoan, Hohaus, 2012, 2015; Hebrew, Schwarzschild, 2014; see also Stassen, 1985). This is so in Nez Perce as well. The examples below show the availability of a comparative structure without *qetu*, in predicative comparison with *-(p)x* 'to' and *-(p)kin'ix* 'from' as well as attributive comparison.

(11) *'Aayat hii-wes kahat'o haama-px*
woman.NOM 3SUBJ-be.PRES short man-to
'The woman is shorter than the man.'

(12) *Taaqc hii-wes (qetu) yaw'ic watiisx-kin'ix*
today.NOM 3SUBJ-be.PRES (MORE) cool one.day.away-from
'Today is cooler than yesterday.'

(13) *Meeli hi-'nip-e himeeq'is 'atoc* [*John-nim-kin'ix 'atoc*]$_{\text{standard}}$
Mary.NOM 3SUBJ-buy-TAM big car John-GEN-from car
'Mary bought a bigger car than John's car.'

One exception to the general optionality of *qetu* concerns cases where the standard is not overt. Like many other languages, Nez Perce allows contextual comparatives, i.e. comparatives in which the standard is not made overt (see Hohaus, 2015 for cross-linguistic discussion).[6] In the absence of an overt standard, *qetu* becomes obligatory:

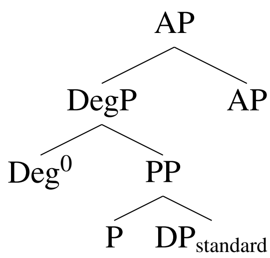
(14) *'Inekiix 'ilcweew'cix hapat'is hii-wes, 'iceyeeye #(qetu) hapat'is hii-wes*
even.though monster.NOM powerful 3SUBJ-be.PRES, coyote.NOM MORE powerful 3SUBJ-be.PRES
'Even though Monster is powerful, Coyote is more powerful.'

We take such data to indicate that Nez Perce adjectives are not inherently comparative in meaning (cp. Oda, 2008 for Japanese). Some explicit structure – either *qetu*, a standard, or both – is required for a comparative interpretation. We suggest that this pattern arises via a processing

[6] Such structures are rather less surprising morphosyntactically in Nez Perce than in English, as Nez Perce generally allows *pro*-drop of all nominal arguments (whether or not they are tracked by overt morphological inflection; Deal, 2010). This suggests that the standard in a case such as (14) may simply be an ordinary *pro*.

preference, as follows. First, following Bresnan (1973), Heim (2000), and many others, we propose that the comparative morpheme heads a phrase (a DegP) which attaches as an adjunct in the AP. The standard phrase is base-generated as the sister to the comparative morpheme. Standards of comparison, like other DPs marked by *-(p)x* or *-(p)kin'ix*, behave as though embedded in a PP structure in Nez Perce (Deal, 2017). Therefore, we propose that the Deg head selects a P head, which in turn assigns case to the DP; thus the comparative structure is responsible for case-assignment to the standard, albeit indirectly.

(15)



We propose that the comparative Deg head may be realized either as *qetu* or as ∅; likewise, the standard may be realized as an overt phrase, or as *pro*. Given that the case on the standard is determined by the DegP structure, overt pronunciation of either element is sufficient to signal the presence of DegP. However, the adjunct status of this phrase makes it such that it will be posited in a syntactic structure only given some form of morphosyntactic evidence. In the absence of any overt material, we assume that the parser does not consider the possibility of a DegP projection. Accordingly, (14) is infelicitous in the absence of *qetu*.

2.2. Semantic properties

Adjectival comparisons in Nez Perce have two basic properties reminiscent of their counterparts in English (and in contrast with their counterparts, such as these are, in Washo). First, they are not norm-related, in the sense of Bierwisch (1989): that is, a tallness comparative does not entail that the standard is not tall, nor that the subject (henceforth: the *associate* of the comparative) is tall. The absence of a norm-related inference concerning the standard is shown in (16) and (17). Example (16) compares the tallness of two very tall humans, basketball players Kareem Abdul-Jabbar and Shaquille O'Neal; this sentence is felicitous despite the fact that Shaq is very tall. Similarly, example (17) shows that a tallness comparative may be felicitously followed by an assertion of the tallness of the standard.

(16) Context: Kareem – 7'2" (218.5cm). Shaq – 7'1" (216cm)
Kareem hii-wes qetu kuhet Shaq-kin'ix
Kareem.NOM 3SUBJ-be.PRES MORE tall Shaq-from
'Kareem is taller than Shaq.'

(17) *John hii-wes qetu kuhet Meeli-px met'u/kaa Meeli 'ipin=k'u*
John.NOM 3SUBJ-be.PRES MORE tall Mary-to but/and Mary.NOM 3SG=EMPH
hii-wes kuhet
3SUBJ-be.PRES tall
'John is taller than Mary but/and Mary is also tall.'

Examples (18) and (19) show the parallel fact for the associate of comparison. (18) shows that a tall person may nevertheless be the associate of a shortness comparison. (19) shows that a single individual may simultaneously be the associate of shortness and tallness comparisons.

(18) *'Aayat hii-wes kuhet met'u hii-wes ∅ kahat'o haama-px*
woman.NOM 3SUBJ-be.PRES tall but 3SUBJ-be.PRES MORE short man-to
'The woman is tall but she's shorter than the man.'

(19) *'Aayat hii-wes qetu kuhet haacwal-px kaa ∅ kahat'o haama-px*
woman.NOM 3SUBJ-be.PRES MORE tall boy-to and MORE short man-to
'The woman is taller than the boy and shorter than the man.'

These facts speak to the semantic relationship between positive adjectives and their comparative counterparts. Whatever the semantics of the comparative operator, it must be such that the context-dependency of the positive form is reduced or changed.

Second, Nez Perce comparatives support crisp judgments: comparatives are never rejected on grounds of insufficient difference between the individuals compared. Thus comparatives are fully acceptable in the case of a very small difference between the standard and the associate in the compared property. In (16), for instance, the difference is 1 inch ($\sim$2.5cm); the comparative is felicitous. Even smaller differences of height also fail to render comparatives infelicitous:

(20) Context: Drea is 5'8" (172.7cm). I am 5'7 3/4" (172.1cm), just a hair shorter.
Drea hii-wes qetu kuhet 'iin-im-x
Drea.NOM 3SUBJ-be.PRES MORE tall 1SG-OBL-to
'Drea is taller than me.'

A related observation is that Nez Perce comparatives are sometimes translated into English with an explicit remark that the difference is small, as in (21). This translation would be surprising if the Nez Perce sentence in fact required a major height difference between the standard and the associate.

(21) *Caan hi-neki-se, Sue hii-wes qetu kuhet 'iin-im-kin'ix*
John.NOM 3SUBJ-think-TAM Sue.NOM 3SUBJ-be.PRES MORE tall 1SG-OBL-from
Speaker: "John thinks Sue is a little bit taller than himself."

Nez Perce comparatives are also different from their English counterparts in several notable ways. First, as noted above, Nez Perce appears to allow only phrasal comparatives, rather than clausal ones; furthermore, its attributive phrasal comparatives are different from (at least apparently) phrasal comparatives in English in lacking the ambiguity seen in (22).

(22) *Mary bought a bigger car than John.*
a. External reading: Mary's new car is bigger than John's car
b. Internal reading: Mary's new car is bigger than John

As the internal reading of (22) may be hard to access, some English examples with prominent internal readings are given in (23):

(23) a. *George owns a faster car than this BMW.* (Lerner and Pinkal, 1995)
b. *Mary bought a faster computer than her old one.* (Berezovskaya and Hohaus, 2015)

In contrast to English, Nez Perce attributive comparatives receive only the internal reading. Two examples of an internal reading are shown in (24) and (25). Note in both cases the genitive marking of a possessor phrase within the standard phrase. In (24), the possessum *'atoc* 'car' is overt within the standard phrase. In (25), the possessum ('shirt') is elided.

(24) *Meeli hi-'nip-e (qetu) himeeq'is 'atoc* [*John-nim-kin'ix 'atoc*]$_{\text{standard}}$
Mary.NOM 3SUBJ-buy-TAM MORE big car John-GEN-from car
'Mary bought a bigger car than John's car.'

(25) *Beth hi-'nip-e qetu sayaq'ic samx̂* [*Taamsas-nim-x ∅*]$_{\text{standard}}$
Beth.NOM 3SUBJ-buy-TAM MORE beautiful shirt Taamsas-GEN-to
'Beth bought a prettier shirt than Taamsas's (shirt).'

The absence of external readings is shown by the parallel examples that omit the possessive marking on *John* and *Taamsas*. In (26), for example, the standard is now simply *John*. Accordingly, the sentence cannot receive an interpretation where Mary's new car is compared to John's car, rather than to John himself. Similar remarks apply to (27).[7]

(26) # *Meeli hi-'nip-e (qetu) himeeq'is 'atoc* [*John-kin'ix*]$_{\text{standard}}$
Mary.NOM 3SUBJ-buy-TAM MORE big car John-from
Rejected as: 'Mary bought a bigger car than John did.'

(27) # *Beth hi-'nip-e qetu sayaq'ic samx̂* [*Taamsas-x ∅*]$_{\text{standard}}$
Beth.NOM 3SUBJ-buy-TAM MORE beautiful shirt Taamsas-to
Rejected as: 'Beth bought a prettier shirt than Taamsas did.'

These judgments are similar to data noted for certain phrasal comparatives in Greek (Merchant, 2012) and Russian (Berezovskaya and Hohaus, 2015). We return to this connection below.

The third notable point of difference is that Nez Perce lacks all differential comparative constructions. Differential comparatives are absent with vague quantificational expressions of difference (e.g. 'a little', 'a lot'), with demonstrations ('this much'), and with precise measures. Attempts at eliciting vague quantificational differential comparatives and demonstrative differential comparatives most often just result in the ordinary comparative (sometimes together with consultant remarks indicating difficulty in translation):

(28) Prompt: John is a lot taller than Mary
Hii-wes Caan qetu kuhet Meeli-px
3SUBJ-be.PRES John.NOM MORE tall Mary-to
Comment: "I don't know how you say that little bit more tall. It's just saying he's taller than Meeli, I don't know how we'd say more than that. It's just saying he's taller than she is."

[7] We provide overall hashtag judgments for these sentences given that speakers rejected them in contexts that only supported the external reading. We expect that these examples are indeed felicitous in contexts that make the internal readings prominent. In addition, for the case of (26), a speaker suggested an alternative (though irrelevant) parse whereby *Johnkin'ix* is a locative source, resulting in the translation 'Mary bought a bigger car from John'.

(29) Prompt: This table is this much bigger than my table (gesturing to indicate a size difference)

Kii hipinwees hii-wes qetu himeeq'is [*'iin-im-kin'ix hipinwees*]
this table.NOM 3SUBJ-be.PRES MORE big 1SG-GEN-from table
lit. 'This table is bigger than my table.'

Attempts at eliciting precise measures of difference result in an assortment of attempted strategies, which speakers are left unhappy with.

(30) Prompt: Beth is 1 foot taller than Mary

Hii-wes, and I don't know how you'd put 1 foot in there, qetu kuhet,
3SUBJ-be.PRES MORE tall,
Meeli-px
Mary-to

(31) Prompt: Mary is 1 foot taller than me

Meeli 'iin-im-x hii-wes naaqc sepiinewit (... *kuhet*)
Mary.NOM 1SG-OBL-to 3SUBJ-be.PRES one measure (... tall)
Comment: "It explains what you're talking about but sometimes we wouldn't use it that way."[8]

The way that speakers respond to this type of translation task suggests that there is an expressive gap and speakers are looking for ways to plug that gap. We conclude that Nez Perce does not provide its speakers with a grammatical means of expressing differential comparatives.

3. Semantics of the adjective and comparative: two hypotheses

One conclusion from the previous section is that Nez Perce is a language intermediate between Washo and English with respect to crisp judgments and differential comparatives. As discussed above, this state of affairs lends itself to two potential approaches to the semantics of the Nez Perce adjective and the comparative word *qetu* – the first "degreeless", the second "degreeful". Under the first analysis, Nez Perce is [-DSP], with vague predicates as in Washo (3). Nez Perce differs from Washo (and other conjoined-comparative languages such as Motu) in possessing a Klein-style comparative operator, (32b).[9,10]

(32) Degreeless analysis: Nez Perce as [-DSP]

a. $[\![\, kuhet \text{ 'tall' }]\!]^c = \lambda x.x$ counts as tall with respect to context c

b. $[\![\, qetu \,]\!] = \lambda x.\lambda P_{\langle \kappa,et\rangle}.\lambda y.\ \exists C'.P(C')(x) = 0 \wedge P(C')(y) = 1$

[8]Note that this comment was immediately followed by a comment about how an additional speaker should be consulted about this prompt. In this way, in addition to the comment quoted, the speaker made it very clear that she had significant doubt about her translation from the English, even though she only says "sometimes".

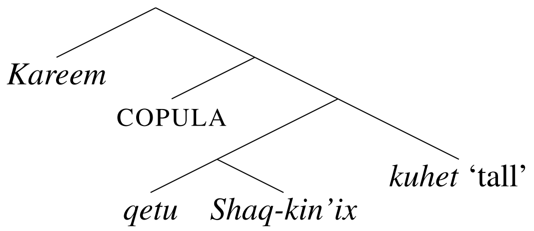
[9]Here we represent contexts as type κ. We assume that composition with the adjectival projection involves a rule of Monstrous Function Application; see Klein (1980: pp. 26-27), Anand (2006) and Deal (2018).

[10]Note that the operator semantics in (32b) potentially raises questions about comparatives with absolutive adjectives such as *k'illiinin* 'bent' and *cuuyekilkin'* 'closed'. The issue is whether there is indeed a context such that (say) a partially bent object fails to count as *k'illiinin* 'bent'. See Burnett (2014) for an approach to this problem that remains compatible with the degreeless analysis of adjectives and comparatives.

For an example like (33a), which has schematic syntactic structure (33b), this approach produces the truth conditions in (33c). These conditions are met iff Kareem is taller than Shaq.[11]

(33) a. *Kareem hii-wes qetu kuhet Shaq-kin'ix* (= (9))
Kareem.NOM 3SUBJ-be.PRES MORE tall Shaq-from
'Kareem is taller than Shaq.'

b.



c. $[\![\text{(33a)}]\!] = 1$ iff $\exists C'.[\![\textit{kuhet}]\!]^{C'}(\text{Shaq}) = 0 \wedge [\![\textit{kuhet}]\!]^{C'}(\text{Kareem}) = 1$
iff $\exists C'$. Shaq does not count as tall with respect to C'
and Kareem counts as tall with respect to C'

This analysis immediately handles the semantic properties of Nez Perce comparatives reviewed in §2.2 without any further stipulations about the lexicon or grammar. It predicts the lack of norm-relatedness in virtue of the fact that $[\![\textit{qetu}]\!]$ involves quantification over contexts. For instance, it is certainly true in any ordinary context of speaking about humans that both Shaq and Kareem count as tall. (Recall that Shaq, the shorter of the two, is 7'1", or 216cm.) With respect to such a context, (34a) will come out as true. The comparative in (33), however, does not depend on whether or not one is in an ordinary context of speaking about humans. It requires only that there be *some* context, regardless of how remote, in which Shaq fails to count as tall, in contrast to Kareem.

(34) a. *Shaq hii-wes kuhet*
Shaq.NOM 3SUBJ-be.PRES tall
'Shaq is tall.'

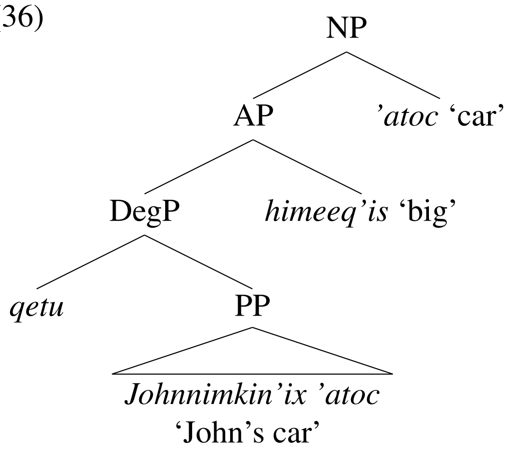
b. $[\![\text{(34a)}]\!]^c = 1$ iff Shaq counts as tall with respect to c

The analysis predicts the crisp judgment effect on the plausible assumption that for any two individuals who differ in height, there will be some context that assigns one to the positive extension of a predicate and the other to the negative extension. (This postulate is formalized in Klein, 1980: 23.) Whether or not the difference is substantial plays no role in determining the partitioning of individuals in a context. It predicts the availability of internal readings in attributive comparatives in a straightforward compositional way, as demonstrated below for the relevant part of the LF of (35).

(35) *Meeli hi-'nip-e (qetu) himeeq'is 'atoc* [*John-nim-kin'ix 'atoc*]$_{\text{standard}}$
Mary.NOM 3SUBJ-buy-TAM MORE big car John-GEN-from car
'Mary bought a bigger car than John's car.'

[11]Properly, the biconditional here requires that we assume that the domain of contexts is sufficiently rich so as to ensure that contexts witnessing the quantification in (33c) are not arbitrarily absent from that domain, even though Kareem is indeed taller than Shaq. We assume that this is so.

(36)



$[\![\text{DegP}]\!]^c = \lambda P_{\langle \kappa, et\rangle}.\lambda y.\exists C'[P(C')(\text{J's car}) = 0 \wedge P(C')(y) = 1]$

$[\![\text{AP}]\!]^c = \lambda y.\exists C'$[J's car does not count as big wrt C′ $\wedge$ y counts as big wrt C′]

$[\![\text{NP}]\!]^c = \lambda y.\exists C'$[J's car does not count as big wrt C′ $\wedge$ y counts as big wrt C′] $\wedge\, y$ is a car

In order to derive an external reading (e.g. in (26)), we would need the compared property not to be bigness, but rather 'bigness of the car (x) bought'. If DegP attaches inside the AP projection, the degreeless semantics for adjectives and predicates provides no straightforward compositional route to such a property. This explains why the external reading is absent.[12] Finally, the absence of differential comparatives is straightforwardly explained by the semantics proposed for Nez Perce adjectives, in exact parallel to the situation for Washo discussed above.

The second hypothesis is a "degreeful" analysis: Nez Perce is a [+DSP] language, with adjective meanings as in English (4). Multiple potential denotations for a phrasal comparative operator are compatible in principle with this analysis (Beck et al., 2012; Berezovskaya and Hohaus, 2015). The proposal in (37b) follows Heim (1985) and Bhatt and Takahashi (2011).

(37) Degreeful analysis: Nez Perce as [+DSP] (to be revised)

a. $[\![$ *kuhet* 'tall' $]\!] = \lambda d.\lambda x.x$ is d-tall

b. $[\![\, qetu \,]\!] = \lambda y.\lambda P_{\langle d,\langle e,t\rangle\rangle}.\lambda x.\text{MAX}(\lambda d.P(d)(x)) > \text{MAX}(\lambda d'.P(d')(y))$ (v. 1)

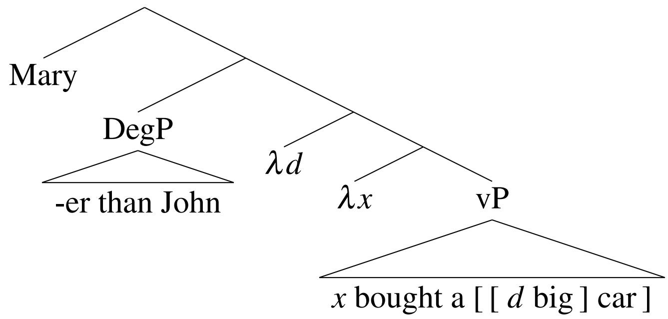
c. $[\![\text{MAX}]\!] = \lambda P_{\langle d,t\rangle}.\iota d.\, \forall d' \in P : d \geq d'$

This style of analysis accounts for the absence of norm-relatedness in a straightforward way: adjective denotations are not themselves context dependent, and they retain that basic character in comparative constructions. The norm-relatedness of positive forms arises via a POS morpheme that combines with adjective roots and delivers context-sensitive, vague predicate denotations (see e.g. Cresswell, 1976, von Stechow, 1984, 2009). In comparatives, the presence of the comparative Deg head makes the presence of POS impossible, leaving no source for norm-relatedness. Equally straightforward is the approach to crisp judgments. The semantics of the comparative requires only that the maximum degree to which the associate is P exceeds the maximum degree to which the standard is P. This holds regardless of how small the difference is between the two.

[12] Assuming that the DegP cannot alternatively be base-generated at some projection above the VP, the external reading could still be derived in a degreeless system if we allowed ourselves to posit a (higher type) Deg^0 operator specifically designed for yielding external readings in attributive comparatives. Given that we know of no evidence for such an element in any language (e.g. in the form of a phrasal comparative type that *only* allows external readings), we do not count the exclusion of this logical possibility as a stipulation about the Nez Perce lexicon.

Turning to attributive comparatives, this analysis makes it straightforward to handle internal readings. However, it is possible to obtain external readings as well: these arise when the associate and the DegP both move, and the DegP takes parasitic scope. This is shown in (38) for the external reading of English example (22).

(38)



To exclude the external reading of Nez Perce sentences like (26), the LF in (38) must be blocked in some way. One possibility is that Nez Perce does not allow its DegPs to move in the required way.[13] Another possibility is that Nez Perce lacks the Heim-style comparative operator presented in (37b), and instead uses the version of a phrasal operator proposed by Kennedy (1997):

(39) $[\![\, qetu \,]\!] = \lambda P_{\langle d,\langle e,t\rangle\rangle}.\lambda y.\lambda x.\text{MAX}(\lambda d.P(d)(x)) > \text{MAX}(\lambda d'.P(d')(y))$ (v. 2)

As should be transparent, this is merely (37b) with the order of its first two arguments reversed. (Accordingly, the adoption of (39) requires a change to the syntax of the comparative: the Deg head now takes the adjective as its sister and the standard as its specifier.[14]) As discussed by Beck et al. (2012), this little change has a significant effect: the external reading is no longer possible. One possible account for the absence of external readings in Nez Perce attributive comparatives is thus a lexical gap: Nez Perce has only phrasal comparative operator (39) and not its close cousin in (37b). Note that the presence of one but not both is not guaranteed by any principle – and indeed, Greek and English seem to be languages that feature both (39) *and* (37b) (Hohaus et al., 2014; Berezovskaya and Hohaus, 2015).[15]

Partially similar remarks apply to differential comparatives. In order to ensure the absence of differential comparatives under a "degreeful" analysis of Nez Perce, we must stipulate that its lexicon does not include a differential Deg^0 version of (39), as in (40):

(40) $[\![Deg_{\Delta}]\!] = \lambda P_{\langle d,\langle e,t\rangle\rangle}.\lambda y.\lambda d''.\lambda x.\ \text{MAX}(\lambda d.P(d)(x)) \geq \text{MAX}(\lambda d'.P(d')(y)) + d''$

[13] This is Merchant's (2012) proposal for the absence of external readings with genitive comparatives in Greek.

[14] We assume that some version of the processing hypothesis presented in section 2.1 could be maintained in this theory, even though DegP is now a projection in the functional spine of the AP rather than an AP adjunct. We will need to ensure in some way, just as before, that a comparative DegP is not posited without any morphosyntactic evidence. In the absence of a visible *qetu* or a standard, the POS version of Deg^0 must be posited. This of course is one difference from the [-DSP] hypothesis, according to which the absence of a comparative DegP structure can be taken by the parser as compatible with no DegP presence at all.

[15] While we will maintain this formulation moving forward, an alternative possibility is that Greek allows one of its comparatives but not the other to QR (see note 13). This requires some information to be attached to the Deg^0 item that determines its QR possibilities, and so the absence of one of the options in a given language would still count as a lexical gap.

Again, we are not aware of any principled reason that such a lexical entry should be absent. In Greek, for instance, the class of comparative structures that disallows external readings in attributive comparatives (viz. genitive comparatives) nevertheless allows differentials (Merchant, 2012: 7). The lack of (40) thus must be posited as an arbitrary gap in the Nez Perce lexicon.

Overall, while the two hypotheses compared in this section are both capable of capturing the basic semantic facts reviewed in section 2.2, there is a difference in the extent to which the facts receive a unified explanation. The difference arises in handling the absence of external readings for attributive comparatives and the absence of differentials. On the [-DSP] analysis, these facts are of a piece with the rest of the system; they could not be otherwise. For attributives, there is no natural degreeless Deg^0 meaning that delivers external readings (and no way to use QR to fill this gap). For differentials, the challenge is that adjective meanings provide not a mapping to points on a degree scale (on which addition might be defined) but rather a simple notion of counting as *p* (e.g. tall) in a context. Here again there is no natural Deg^0 meaning that combines with a $\langle e,t\rangle$ adjective to produce the desired meaning. This situation contrasts with the [+DSP] analysis, on which the Deg^0 meanings required for external readings and differential comparatives are not only natural but indeed attested in natural language. Accordingly, the [+DSP] analysis of Nez Perce requires that we describe not only what *is* in this language's lexicon but also what natural meanings are *not* in it, in order to provide a full account.

(41) Degreeful analysis: Nez Perce as [+DSP] (to be augmented)

a. $[\![\textit{kuhet} \text{ `tall'}]\!] = \lambda d.\lambda x.x \text{ is } d\text{-tall}$

b. $[\![\textit{qetu}]\!] = \lambda P_{\langle d,\langle e,t\rangle\rangle}.\lambda y.\lambda x.\text{MAX}(\lambda d.P(d)(x)) > \text{MAX}(\lambda d'.P(d')(y))$ (final)

c. The lexicon lacks Deg_{Δ} as in (40) and a meaning for *qetu* as in (37b).

This difference in the complexity of the analysis provides a first reason to favor the [-DSP] analysis over the [+DSP] one. Such arguments, of course, are always subject to revision, should we encounter some other phenomena that require added complexity in the opposite direction. Accordingly, we turn next to some additional cases where we might hope to see clear evidence of degree semantics if Nez Perce is indeed [+DSP].[16]

4. In search of degrees beyond comparatives

Degree questions offer a prime opportunity to see a degree semantics for adjectives, as in (41a), at work. In an English question like (42), the *wh*-operator *how* binds the degree argument slot of the adjective, quantifying over degrees; the adjective determines the scale on which the relevant degrees are to be localized.

(42) How big is Calvin?
$\approx$ What is the maximum degree *d* such that Calvin is *d*-big?

Nez Perce does not have a degree question formation strategy parallel to (42). Instead, to express this type of meaning, it has recourse to a special set of *wh*-words that encode both

[16]Note that, for reasons of space, we set aside superlatives and equatives; Nez Perce does not have dedicated morphology for either, which we take to require a lexical gap on either analysis.

interrogation *and* dimension: *masł* 'how big', *mahal* 'how long' and *mac* 'how many/ much'.[17] While these dimensional *wh*-words are clearly bi-morphemic, containing *wh*-morpheme *m-* (also found in *mawa* 'when' and *mine* 'where'), the *wh*-morpheme attaches not to an adjective but rather to a bound dimensional root. Contrast *masł* 'how big' with the various size adjectives found in the language:

(43) a. *masł* 'how big', **asł*, **'asł*
b. *himeeq'is* 'big' (sg), *titilu* 'big' (pl), *kuckuc* 'small'

Questions featuring the dimensional *wh*-words do not contain adjectives specifying a dimension, and such adjectives cannot be added:

(44) a. *Masł wiseliikt wees?*
how.big standing be.PRES
'How tall are you?'

b. *Mahal pi'amx-no'?*
how.long meet-FUT
'How long will they meet for?'

(45) *Mac we 'inmiiwit?*
how.many be/have years
'How many years do you have? (= 'How old are you?')[18]

We suggest that the bound dimensional roots *-asł*, *-ahal*, and *-ac* denote not sets of individuals (as adjectives do, on the analysis in (32a)) but rather sets of equivalence classes of individuals in terms of a specified dimension, as sketched for *-asł* in (46). In (44a), the *m-* question operator then asks which sized-based equivalence class the addressee falls within when standing.

(46) $[\![\, \textit{-asł}\,]\!]^c = \lambda P_{\langle e,t \rangle}. \forall x,y \in P\, [\forall c' [x \text{ counts as big wrt } c' \leftrightarrow y \text{ counts as big wrt } c']]$

Of course, reference to equivalence classes of individuals, as in (46), precisely recalls Cresswell's (1976) understanding of degrees (and so (46) can be easily rewritten in a way that foregrounds sameness of degree of size). We conclude, then, that there is a sense in which Nez Perce is certainly not 'degreeless', even if it is [-DSP]. It makes use in some way of equivalence classes. We do not, however, think that this very strong sense of 'degreeless' is likely to be a source of cross-linguistic semantic variation, given that recognition of sameness is cognitively fundamental: a truly 'degreeless' language in this sense would need to lack numerals (which require numerosity equivalence classes), tenses (which require temporal equivalence classes), etc. In this sense it should perhaps not be surprising to see equivalence classes play a role in some way even in the semantics of a [-DSP] language. And so we conclude that degree questions in Nez Perce are compatible with a [-DSP] analysis. What must be stipulated on this analysis is the absence of a general operator that could map adjective meanings into properties of equivalence classes as in (46). The [+DSP] analysis must make a parallel stipulation (since

[17] This seems to be the exhaustive list of such dimensional *wh*-words for current speakers. Further fieldwork is required to confidently report the way that Nez Perce speakers ask questions about dimensions beyond size, length, and quantity. Initial evidence suggests that they simply prefer to ask yes/no questions concerning these dimensions (e.g. difficulty, depth). Note that speakers oftentimes give yes/no translations also for English degree questions that feature size, length, and quantity – e.g. 'Is B tall?' instead of a form using *masł* 'how big'.

[18] Note that the form of the copula here is only found with 1st/2nd person arguments, indicating a 2nd person somewhere in the structure. The subject here is plausibly [pro *'inmiiwit*] 'your years'.

meanings like (46) remain possible on this analysis), and it must also stipulate that Nez Perce lacks a *wh*-word like 'how' which can simply combine with adjectives as is (presumably as a Deg^0). Once again, slightly more complexity is required of the [+DSP] analysis.

We turn next to measure phrases, as exemplified by English (47). Here, on a [+DSP] analysis, the measure phrase quantifies over (in the case of *6 feet*) or refers to (in the case of demonstrative *this*) degrees of Mary's height. If pronominal, it may simply saturate the degree argument position provided by the adjective; if quantificational, it may QR and bind a degree variable in this position.

(47) *Mary is {6 feet / this} tall.*

Nez Perce adjectives do not allow measure phrases. Notably, this is not for a want of ways in which measures themselves may be expressed. Pronominal measure phrases are formed via the bound dimensional roots *-asł* and *-ahal* with the addition of demonstrative morpheme *k-* (also found in a full range of demonstratives, such as *kine* 'here', *kona* 'there', *kawa* 'then'), sometimes preceded by *kii* 'this'.[19] In addition, Nez Perce has two general measure words, *temiinewit* 'weight measure' and *sepiinewit* 'length measure', both formed by nominalization from a basic root *hiinewi* (Aoki, 1994: pp. 150-151). Also possible are more specific units such as *'aatim* 'yard (lit. arm)' and *kicuy* 'dollar (lit. money)'. The crucial observation is that expressions of measure consistently do not include adjectives:

(48) *(kii) k-asł wees ciq'aamqal*
this DEM-SIZE.EQUIV be.PRES dog
'My dog is this big' [said with a hand gesture]

(49) *samq'ayn sepiinewit hii-wes lepit 'aatim*
cloth length.measure 3SUBJ-be.PRES two arm
'The cloth is two yards long.'

From the perspective of a [+DSP] analysis, the obligatory absence of adjectives in such predications is surprising. If Nez Perce measure phrases indeed denote or quantify over degrees, some stipulation is required to the effect that measure phrase arguments to adjectives are not permissible syntactically (despite the fact that they would be perfectly appropriate semantically, in the quantificational case with the addition of QR). On a [-DSP] analysis, by contrast, measure phrases may be taken to denote equivalence classes (Klein, 1980; type $\langle e,t \rangle$), such that (for instance) *lepit 'aatim* 'two yards' refers to the equivalence class of two-yard-long objects and *kasł* 'this big' refers to the class of objects equivalent in size to the size being demonstrated. From this perspective, sentence (48) is straightforwardly predicative: the dog is a member of the demonstrated equivalence class. Of course, given an $\langle e,t \rangle$ semantics for Nez Perce measure phrases, we would not expect them to behave as arguments to adjectives. At best we might expect them to be able to modify adjectives (though note that this would produce a reading that is norm-related). A syntactic stipulation is presumably required to rule this out. And of course a hybrid analysis that adopts a [+DSP] analysis of adjectives but an equivalence class analysis of

[19] Note that there is no *k-ac* 'thus many'.

measure phrases must make both types of stipulations: it must stipulate that degree-based measure phrases are unavailable *and* that equivalence-class-based measure phrases cannot modify adjectives.

Finally, we consider the construction that Beck et al. (2009) call "comparison with a degree":

(50) *Mary is taller than 5 feet.*

In a language with only phrasal comparatives, we expect the standard of comparison to be of type e. (Indeed, both approaches to Nez Perce we have developed thus far are united in this assumption.) Thus, if the language had pronouns of type d, or quantifiers of type $\langle\langle d,t\rangle,t\rangle$, we would not expect to see them appear as the standard of comparison. By contrast, we have argued above that the language has expressions that refer to equivalence classes of individuals, such as *lepit 'aatim* 'two yards' and *kasł* 'this big'. These classes are natural standards of comparison, given their internal equivalence. One would only need to apply a choice function to these classes to return a type e standard for comparison. And that is exactly what we suggest occurs in Nez Perce sentences such as the following:

(51) *Samq'ayn hii-wes qetu kuhet* [*naaqc 'aatim-kin'ix*]
cloth 3SUBJ-be.PRES MORE tall one arm-from
'The cloth is longer than one yard.'

(52) [*Kinee-pkin'ix kasł*] *'iin-im ciq'aamqal hii-wes qetu himeeq'is*
this-from thus.sized 1SG-GEN dog 3SUBJ-be.PRES MORE big
'My dog is bigger than this.' [gesturing to indicate a standard]

We take the primary upshot of these facts to be a further support for the analysis of Nez Perce measure phrases as referring to equivalence classes. The (misnamed, from this perspective) "comparison with a degree" construction shows us that these measure phrases have an important similarity with individuals. What they do *not* do is behave as arguments for adjectives, as would be expected on a [+DSP] analysis.

An overall conclusion from this section is that the investigation of degree questions, measure phrases, and "comparison with a degree" does not turn up any new evidence tipping the scale of parsimony back in favor of a [+DSP] analysis. Quite to the contrary, the facts of this section show that the overall stipulation scoreboard for the degreeful analysis in (41) must be augmented. The Nez Perce lexicon would contain two additional types of arbitrary lexical gaps, in addition to the curious addition of a workaround for these gaps that does not feature degrees:

(41) d. The lexicon lacks a counterpart of English degree *how* and all degree-based measure phrases.
e. There are equivalence-class-based dimensional roots and measure phrases.

Again, the [-DSP] analysis provides a more unified account. It explains why degree *how* and degree-based measure phrases are absent; there is no way to compose such elements with adjectives. And it explains why equivalence classes play the role that they do, and their curious similarity to standards of comparison.

5. Conclusions

Beck et al.'s (2009) and Bochnak's (2015) arguments for [-DSP] languages are based on a parsimony argument: the [-DSP] analysis provides a unified explanation for why certain languages lack a whole suite of degree morphology. In this paper, we have made a parallel argument for Nez Perce: the [-DSP] analysis requires fewer independent stipulations about the lexicon than the [+DSP] alternative. Our evidence suggests that the simplex comparative comes apart from the differential comparative, external readings of attributives, adjective-based degree questions, and degree-based measure phrases due to the ease with which the simplex comparative, but not its degree cousins, can be expressed in terms of quantification over contexts. This provides new reason to take seriously the delineation semantics proposal from Klein (1980) as an account of how gradable predicates and comparatives may work in natural language. It points up the need for further investigation of the internal semantic diversity of [-DSP] languages, and in particular, the extent to which such languages use equivalence classes of individuals in place of a full-blown additive and multiplicative system of degrees.

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Dynamic inquisitive semantics: Anaphora and questions[1]

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Abstract. This paper develops a dynamic inquisitive semantics and illustrates its potential to capture interactions between anaphora and questions.

Keywords: dynamic semantics, inquisitive semantics, anaphora, questions.

1. Introduction

This paper develops a new logical framework for the analysis of questions, bringing together insights from dynamic semantics (Kamp, 1981; Heim, 1982; Groenendijk and Stokhof, 1991) and inquisitive semantics (Ciardelli et al., 2018).

One important advantage of dynamic approaches to questions over static ones is that they allow for a straightforward account of discourse anaphora with wh-antecedents, exemplified in (1):[2,3]

(1) Which^x of your new dresses did you wear today? Did Peter like it$_x$?

However, existing dynamic theories of questions which capture such cases of anaphora (Groenendijk, 1998; van Rooij, 1998; Haida, 2007) are all built on the idea that questions induce a *partition* on the set of all possible worlds (Groenendijk and Stokhof, 1984), which is known to have certain shortcomings. In particular, while it is designed to capture the *exhaustive* interpretation of questions like (2), whose resolution requires identifying all participants that ordered a vegetarian lunch, it does not straightforwardly capture the *non-exhaustive* interpretation of questions like (3), whose resolution only requires identifying one person who has a bike to borrow.

(2) Which participants have ordered a vegetarian lunch?

(3) Who has a bike that I could borrow for 15 minutes?

This and other limitations of partition semantics have been addressed in recent work on *inquisitive semantics* (Ciardelli et al., 2018). In particular, exhaustive and non-exhaustive question interpretations can both be captured straightforwardly in this framework.

The aim of the present paper is to integrate the main insights from dynamic and inquisitive semantics in a way that preserves the benefits of both. We will not, however, develop a full-fledged compositional dynamic inquisitive semantics here. Rather, we will present a simple, first-order system, which is intended to serve as the dynamic inquisitive counterpart of standard first-order logic. While for detailed analysis of certain linguistic phenomena such a first-order

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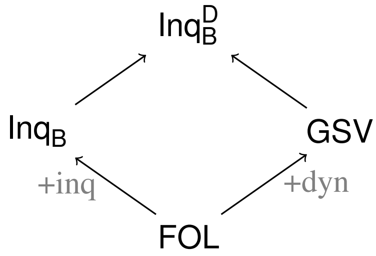
[2]Throughout, relevant antecedents are superscripted with an index corresponding to the discourse referent they introduce and anaphora are subscripted with an index corresponding to the discourse referent they pick up.

[3]Other advantages of a dynamic semantic treatment of questions are discussed in Aloni and van Rooij (2002), Isaacs and Rawlins (2008), and Haida (2007). We will focus here on anaphora.

system is certainly not sufficient, it is an important first step in the direction of a full-fledged framework, and its relative simplicity will make it easier to explain the main underlying ideas.

The system to be presented here combines the basic first-order inquisitive system $\mathsf{Inq_B}$ (Ciardelli et al., 2018) with the first-order dynamic system of Groenendijk, Stokhof, and Veltman (1996), which we will refer to as GSV. We will refer to the resulting system as $\mathsf{Inq_B^D}$.[4] The various systems are depicted to the right, together with standard first-order logic (FOL). In this figure, an arrow from one system to another indicates that the latter is an extension of the former (modulo modality, see fn. 4).



The structure of the paper is as follows. Sect. 2 discusses how conversational contexts are modelled in $\mathsf{Inq_B^D}$, Sect. 3 discusses notions related to context update, Sect. 4 provides a dynamic inquisitive semantics for a first-order language, and Sect. 5 illustrates how the framework can be used for the semantic analysis of declarative and interrogative sentences in English, showing in particular that it can capture anaphora with wh-antecedents in non-exhaustive wh-questions, as well as anaphora with indefinite antecedents in polar questions. Sect. 6 concludes.

2. How to model contexts?

In dynamic semantics the meaning of a sentence is viewed as its *context change potential*. One common way to formalize this idea is to take the semantic value of a sentence to be a function that maps any input context (the context in which the sentence is uttered) to a corresponding output context (the new context after the utterance).

2.1. Contexts in GSV

In GSV contexts are modelled in such a way that they capture two types of information that the conversational participants have established as common knowledge in the conversation so far: (i) information about the *world* (e.g., that it's Tuesday), and (ii) information about the *discourse referents* that have been introduced so far (e.g., that the first discourse referent denotes Alice and the second a friend of hers).

Formally, this is achieved by modelling a context as a set of pairs $\langle w, g \rangle$, where w is a possible world and g an assignment function mapping every discourse referent introduced so far to an individual. Such pairs are called *possibilities*. A context C formally represented as a set of possibilities captures information about the world, namely the information that the actual world coincides with some w such that $\langle w, g \rangle \in C$, as well as information about discourse referents, namely the information that the individuals they refer to must be as specified by some g such that $\langle w, g \rangle \in C$. Finally, it also captures possible *dependencies* between these two types of information. For example, it may be known that one discourse referent denotes either Alice or Kim, and that the actual world is one in which this discourse referent denotes the tallest woman on earth. Further, it may be known that the second discourse referent is a friend of the woman

[4] GSV in turn combines the dynamic predicate logic of Groenendijk and Stokhof (1991) with the update semantics of Veltman (1996) and its main focus is to account for the dynamic properties of indefinites and modals within one framework. We will leave out the analysis of modals from $\mathsf{Inq_B^D}$.

denoted by the first discourse referent (Sue for Alice; Mary for Kim). In this context, the value of the second discourse referent depends on that of the first, and the value of the first discourse referent depends on what the world is like.

While in GSV contexts are modelled in such a way as to represent both information about the world and about discourse referents, they do not represent the *issues* that may have been raised about the world and about the discourse referents. Raising such issues is the primary conversational role of questions. Thus, in a dynamic framework for question semantics, the notion of contexts must be richer than in GSV: it has to represent both the information that has been established and the issues that have been raised.

2.2. Contexts in $\mathsf{Inq_B}$

In $\mathsf{Inq_B}$, contexts represent information and issues about the world. Formally, this is achieved by modelling contexts as *sets of information states*, where each information state in turn is a set of possible worlds. The information states that make up a context C are precisely those that (i) contain enough information to resolve the issues that have been raised in the conversation so far and that (ii) do not contain any possible worlds that are already ruled out by the information established in the conversation so far. The union of all the elements of C, $\bigcup C$, is precisely the set of worlds which are compatible with the information available in C. This union is denoted as $\textsc{info}(C)$.

Not just any set of information states constitutes a proper context representation in $\mathsf{Inq_B}$. Rather, this only holds for sets of information states that are *downward closed*: if they contain a certain information state s, they must also contain all stronger information states $s' \subset s$. This requirement follows from how contexts are construed. To see this, suppose that a context C contains an information state s. This means (i) that s contains enough information to resolve the contextual issues and (ii) that s does not contain any possible worlds that are ruled out by the information available in C. But then, the same goes for any stronger information state $s' \subset s$, which in turn means that these stronger information states must also be in C.

Furthermore, it is assumed in $\mathsf{Inq_B}$ that the inconsistent information state, $\emptyset$, trivially resolves any issue and is therefore contained in any context representation. Given the requirement that contexts are downward closed, the additional requirement that any context contains $\emptyset$ is equivalent to the requirement that any context be non-empty.

In sum, contexts are modelled in $\mathsf{Inq_B}$ as non-empty, downward closed sets of information states, which in turn are sets of possible worlds. This allows us to represent both information and issues about the world. However, information and issues about discourse referents are not represented.

2.3. Contexts in $\mathsf{Inq_B^D}$

The context representations used in GSV and in $\mathsf{Inq_B}$ need to be integrated in order to arrive at a notion of context that comprises both information and issues about the world as well as about the discourse referents introduced so far.

How should this be done? As a starting point, note that the formal objects that are used to represent contexts in GSV, i.e., sets of world-assignment pairs (possibilities), can also be thought of as representing information states, comprising both information about the world and about the discourse referents. Using this as our notion of information states, we can construe a context exactly as in $\mathsf{Inq_B}$, i.e., as a non-empty, downward-closed set of information states. We think of these information states, just like in $\mathsf{Inq_B}$, as those that (i) contain enough information to resolve the contextual issues, and (ii) do not contain any possibilities that are ruled out by the contextually established information. Only now, the contextual issues and the contextually established information may not only pertain to what the world is like but also to the values of the discourse referents that have been introduced. This way, our new notion of context encompasses both information and issues about the world and about discourse referents.

As in $\mathsf{Inq_B}$, the union of all the information states in a context C, $\bigcup C$, is the set of possibilities which are compatible with the information available in C. We can thus still write $\textsc{info}(C)$ for $\bigcup C$.

2.4. Formal definitions

We now provide explicit formal definitions of the notions discussed above. In order to do this, we consider a first-order logical language L with individual constants, variables, relation symbols, and the standard connectives and quantifiers (some non-standard operators will be added later). We use V to denote the set of variables in L, and we define a model for L as a triple $M = \langle W, D, I \rangle$, where W is a set whose elements are called possible worlds, D a set which is referred to as the domain of the model, and I a world-dependent interpretation function, i.e., for every world $w \in W$, $I(w)$ is a function that maps every individual constant c in L to an individual in D, denoted as $[c]^{M,w}$, and every n-ary relation symbol R in L to a set of n-tuples of individuals in D, denoted as $[R]^{M,w}$. Throughout the discussion below we assume a particular model M and suppress M-indices on $[c]^{M,w}$ and $[R]^{M,w}$. Finally, we define an assignment function g with domain $r \subseteq V$ as a function that maps every variable $x \in r$ to some individual in D, denoted as $[x]^g$.

Definition 1 (Possibilities)**.** For any set of variables $r \subseteq V$, thought of as a set of active discourse referents, we define a *possibility* with domain r as a pair $\langle w, g \rangle$, where $w \in W$ is a possible world and g an assignment function with domain r.

Definition 2 (Information states)**.** For any $r \subseteq V$, an *information state* s with domain r is a set of possibilities such that the union of the domains of all the possibilities in s is r.

Definition 3 (Downward closed)**.** A set of information states S is *downward closed* just in case for every $s \in S$, every subset of s is also in S.

Definition 4 (Contexts)**.** For any $r \subseteq V$, a *context* C with domain r is a non-empty, downward closed set of information states such that the union of the domains of all the information states in C is r.

Definition 5 (The information available in a context)**.** For any context C, $\textsc{info}(C) := \bigcup C$.

2.5. Informed and inquisitive contexts

A context with domain r contains non-trivial information just in case $\textsc{info}(C)$ excludes at least one possibility with domain r.

Definition 6 (Informed contexts)**.** A context C with domain r is *informed* just in case there is a possibility i with domain r such that $i \notin \textsc{info}(C)$.

Resolving the open issues in a context C requires extending the contextually available information, represented by $\textsc{info}(C)$, in such a way as to reach one of the information states in C. In case $\textsc{info}(C)$ is itself an element of C, all the contextual issues are already resolved, i.e., there are no *open* issues in C. In this case, we say that C is *non-inquisitive*. On the other hand, if $\textsc{info}(C) \notin C$ we say that C is *inquisitive*.

Definition 7 (Inquisitive contexts)**.** A context C is *inquisitive* just in case $\textsc{info}(C) \notin C$.

Given a context C, we can always construct a context $!C$ which contains exactly the same information as C, both about the world and about the discourse referents introduced so far, but is not inquisitive. This is achieved by letting $!C$ consist of the information state $\textsc{info}(C)$ plus all subsets thereof. We will refer to this context as the *non-inquisitive closure* of C. In the definition below we use a downarrow to represent closure under subsets, i.e., for any set of information states S, $S^{\downarrow} := \{s' \mid s' \subseteq s \text{ for some } s \in S\}$.

Definition 8 (Non-inquisitive closure)**.** For any context C, $!C := \{\textsc{info}(C)\}^{\downarrow}$

Since contexts are always downward closed they are often fully determined by their *maximal elements*.[5] These elements are information states which contain *just enough* information to resolve the contextual issues. Non-maximal elements also contain enough information to resolve these issues, but they contain more information than is strictly needed to do so. The maximal elements of a context are referred to as the *alternatives* in that context.

Definition 9 (Alternatives)**.** An *alternative* in a context C is an information state $s \in C$ which is such that C does not contain any strictly weaker information state $t \supset s$.

It generally holds that if a context C contains more than one alternative, it is inquisitive. Vice versa, if a context is non-inquisitive, then it contains only one alternative.

Finally, we define trivial contexts, the initial context, and the inconsistent context.

Definition 10 (Trivial / initial / inconsistent contexts)**.** A context is *trivial* just in case it is neither informed nor inquisitive. The *initial* context $C_{\top}$ is the trivial context whose domain is empty. The inconsistent context $C_{\bot} := \{\emptyset\}$ is one in which all possible worlds have been excluded.

3. Context update

Now that we have spelled how contexts are modelled in $\mathsf{Inq}^{\mathsf{D}}_{\mathsf{B}}$, we turn to notions pertaining to context update.

3.1. Extension and subsistence

Updating a context normally leads to an *extension* of that context. When exactly does one context count as an extension of another? In $\mathsf{Inq}_{\mathsf{B}}$, where information states are sets of worlds, the answer to this question is simple, namely, C' is an extension of C if and only if $C' \subseteq C$. This

[5]In particular, a context is *always* fully determined by its maximal elements in case the set of all possibilities is *finite*, which can be assumed in all our examples.

guarantees not only that C' contains at least as much information as C but also that the open issues in C' subsume those in C, in the sense that any piece of information that resolves the open issues in C' also resolves those in C.

In $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$, however, where information states are sets of possibilities, set inclusion is not the right notion of context extension. To see this, consider two contexts, $C = \{\{\langle w, g\rangle\}\}^{\downarrow}$ and $C' = \{\{\langle w, g'\rangle\}\}^{\downarrow}$, where the domain of g is $\{x\}$, that of g' is $\{x, y\}$, and g' agrees with g on the value of x, i.e., $g'(x) = g(x)$. Both C and C' carry the same information about the world. The only difference is that C pertains to a situation in which there is a single discourse referent, x, whereas C' pertains to a situation in which there is another discourse referent, y, as well. In this case we would like to say that C' is an extension of C. After all, all the information available in C is also available in C', together with additional information about the discourse referent y. Yet, $C' \not\subseteq C$. This shows that set inclusion is not the right notion of context extension in $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$.

Groenendijk et al. (1996) specify a natural notion of extension which fits their notion of information states as sets of possibilities. This can readily be adapted to our purposes.

Definition 11 (Extending possibilities)**.** A possibility $\langle w', g'\rangle$ is an *extension* of another possibility $\langle w, g\rangle$ if and only if $w' = w$ and $g' \supseteq g$. In this case we write $\langle w', g'\rangle \geq \langle w, g\rangle$.

Definition 12 (Extending information states)**.** An information state s' is an *extension* of another information state s if and only if every possibility in s' is an extension of some possibility in s. In this case we write $s' \geq s$.

Definition 13 (Extending contexts)**.** A context C' is an *extension* of a context C if and only if every state in C' is an extension of some state in C. In this case we write $C' \geq C$.

It is useful to also define a specific kind of context extension, one which only involves the addition of new discourse referents. Obviously, this type of extension has no counterpart in Inq_B. In GSV it is called *subsistence* and we will use the same term here.

Definition 14 (Subsistence of one state in another)**.** Let s, s' be information states such that $s' \geq s$. Then we say that s *subsists* in s' if and only if every possibility in s has an extension in s'.

Definition 15 (Subsistence of a state in a context)**.** Let s be a state and C a context. We say that s subsists in C if and only if there is at least one $s' \in C$ such that s subsists in s'. We call every s' in C that satisfies this condition a *descendant* of s in C.

Definition 16 (Subsistence of contexts)**.** Let C, C' be two contexts such that $C' \geq C$. Then we say that C *subsists* in C' if and only if every state in C subsists in C'.

3.2. Support, consistency, and entailment

The semantic value of a sentence in $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$ is a function from contexts to contexts, as is common in dynamic semantics. Given any context C and sentence φ, we will write $C[\varphi]$ to denote the context that results from updating C with φ. $C[\varphi][\psi]$ denotes the result of first updating C with φ, and then updating the output context with ψ.

Update functions can be partial. If a context C contains an information state that has a possibility with domain r and an atomic sentence φ contains a variable that is not in r, then the update of C with φ is undefined. This undefinedness percolates up to sentences containing φ.[6]

Under which circumstances are the information conveyed and the issues raised by a sentence φ consistent with or already supported by a given context C? Following GSV, we say that C supports φ just in case updating C with φ does not have any effect beyond the potential addition of discourse referents, and that φ is consistent with C just in case updating C with φ does not lead to the inconsistent context, $\{\emptyset\}$.

Definition 17 (Support)**.** A context C supports φ if and only if $C[\varphi]$ is well-defined and C subsists in $C[\varphi]$.

Definition 18 (Consistency)**.** A sentence φ is consistent with a context C if and only if $C[\varphi]$ is well-defined and $C[\varphi] \neq \{\emptyset\}$.

Finally, we specify when one sentence entails another. In static semantics, entailment is defined in terms of set-inclusion. In dynamic semantics, this is not the right notion, for reasons similar to those discussed in Sect. 3.1 pertaining to context extension. Rather, following Groenendijk et al. (1996) and much other work in dynamic semantics, we define entailment in terms of support.

Definition 19 (Entailment)**.** A sentence φ entails another sentence ψ, written $\varphi \models \psi$, if and only if for every context such that $C[\varphi][\psi]$ is well-defined, $C[\varphi]$ supports ψ.

3.3. Informative and inquisitive sentences, contradictions and tautologies

A sentence is informative just in case it has the potential to turn an uninformed context into an informed one. Similarly, a sentence is inquisitive just in case it has the potential to turn a non-inquisitive context into an inquisitive one.

Definition 20 (Informative and inquisitive sentences)**.**

- A sentence φ is informative if and only if there exists an uninformed context C such that $C[\varphi]$ is well-defined and informed.
- A sentence φ is inquisitive if and only if there exists a non-inquisitive context C such that $C[\varphi]$ is well-defined and inquisitive.

A sentence is contradictory if updating any context with it leads to the contradictory context. On the other hand, a sentence is tautologous if updating a context with it never has any effect.

Definition 21 (Contradictions and tautologies)**.**

- A sentence φ is a contradiction if and only if for any context C: $C[\varphi] = \{\emptyset\}$.
- A sentence φ is a tautology if and only if for any context C: $C[\varphi] = C$.

4. Semantics for a first-order language

We now turn to the semantics of $\mathsf{Inq}_{\mathsf{B}}^{\mathsf{D}}$, i.e., a recursive definition of the context change potential of all sentences in our logical language.

[6]This condition resembles presupposition, but it cannot be expressed in the object language. Groenendijk et al. (1996) call it 'meta-presupposition'.

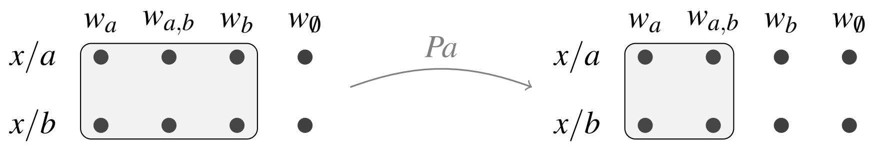


Figure 1: The update effect of an atomic sentence, Pa. Each black dot is a possibility and the shaded rectangles represent alternatives. The world component of each possibility is specified above it, and the assignment component is specified to the left. w_a is a world in which only a has the property P, and similarly for other worlds. x/a represents an assignment which maps x to a, and similarly for other assignments. The update function expressed by Pa is a function which maps the input context on the left to the output context on the right.

4.1. Atomic sentences and conjunction

We start with the two most basic cases: atomic sentences and conjunctions. The update function expressed by an atomic sentence $Rt_1 \ldots t_n$ is defined as the function which, when applied to a context C, retains only those information states in C which are such that $Rt_1 \ldots t_n$ is true across all possibilities in it. As usual, if t is a term, i.e., an individual constant or a variable, we write $[t]^{w,g}$ for the denotation of t relative to w and g. If t is an individual constant then $[t]^{w,g}$ amounts to $[t]^w$; if t is a variable it amounts to $[t]^g$.

(4) $C[R(t_1 \ldots t_n)] = \{s \in C \mid \text{for every possibility } \langle w,g \rangle \in s : \langle [t_1]^{w,g}, \ldots, [t_n]^{w,g} \rangle \in [R]^w\}$

We assume that our logical language contains a designated atomic sentence $\top$ with a trivial update effect.

(5) $C[\top] = C$

Conjunction is taken to express sequential update.

(6) $C[\varphi \wedge \psi] = C[\varphi][\psi]$

To illustrate the semantics we will make use of diagrams representing input and output contexts. Fig. 1 illustrates the interpretation of an atomic sentence.

4.2. Introducing new discourse referents: existential quantification

Existential quantifiers introduce new discourse referents. We define what this means incrementally, first specifying what it means for a possibility to be extended with a new discourse referent, and then doing the same for contexts. Intuitively, if C is a context with domain r then extending the context with x, $C[x]$, creates the largest context with domain $r \cup \{x\}$ such that every $s' \in C[x]$ is an extension of some $s \in C$ and every possibility in every $s' \in C[x]$ assigns a value to x.

Definition 22 (Adding discourse referents to possibilities)**.**
Let $i = \langle w,g \rangle$ be a possibility with domain r, and x a variable such that $x \notin r$.
Then $i[x/d] = \langle w,g' \rangle$, where $g'(x) = d$ and $g'(y) = g(y)$ for all $y \neq x$ in r.

Definition 23 (Extending contexts with discourse referents)**.**
Let C be a context with domain r, and let $x \notin r$. Then:

(7) $C[x] := \{\ \{i[x/d] \mid i \in s \text{ and } (i,d) \in \Delta\} \mid s \in C,\ \Delta \text{ a relation between } s \text{ and } D\}$

Given these definitions, an existentially quantified sentence $\exists x\varphi$ can be interpreted simply as introducing a new discourse referent x and then updating with φ.

(8) $C[\exists x\varphi] = C[x][\varphi]$

Existential quantifiers are not inquisitive in $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$, unlike in Inq_B. The rationale behind this will become clear in Sect. 4.4. For now, let us illustrate with an example, $\exists xPx$. Suppose that D contains only two entities, a and b. In Inq_B, $\exists xPx$ is inquisitive: its semantic value contains two maximal states, one of which consists of all worlds in which Pa holds, and the other of all worlds in which Pb holds. In $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$, the sentence maps an input context C to the output context $C[x][Px]$. The first update simply extends every state in C in such a way that possibilities are expanded with arbitrary values for x. The second update eliminates all states that contain a possibility in which Px does not hold. If C is the initial context, the output context contains just one maximal state, consisting of all possibilities $\langle w, g\rangle$ such that $[x]^{w,g}$ is in $[P]^w$. To make this more concrete, let us use subscripts on worlds to indicate the extension of P at that world and let us write $g_{x/d}$ for an assignment that assigns d to x. Then, as depicted in Fig. 2, the unique maximal state in the output context is $\{\langle w_{a,b}, g_{x/a}\rangle, \langle w_{a,b}, g_{x/b}\rangle, \langle w_a, g_{x/a}\rangle, \langle w_b, g_{x/b}\rangle\}$.

4.3. Raising issues: disjunction

Our treatment of disjunction stays very close to Inq_B. Namely, we assume that the result of updating a context C with a disjunction $\varphi \vee \psi$ is the union of $C[\varphi]$ and $C[\psi]$.

(9) $C[\varphi \vee \psi] = C[\varphi] \cup C[\psi]$

Just like in Inq_B, disjunctions can be *inquisitive*, i.e., they can turn a non-inquisitive context into an inquisitive one. This is illustrated in Fig. 3, where the input context contains a single alternative, but the output context contains two alternatives, each corresponding to one of the disjuncts, and is therefore inquisitive.[7]

Many dynamic semantic theories, including GSV, assume that disjunction is 'externally static', i.e., that discourse referents introduced by one of the disjuncts cannot be picked up by anaphoric expressions outside of the disjunction. Cases like (10) support this. However, Stone (1992) observes that disjunction in natural language is not always externally static, as witnessed by (11).

[7] A word of caution: this does not mean that we take declarative disjunctive sentences in English to be inquisitive. As will be discussed in Sect. 5, we assume that declarative sentences are headed by an operator which discharges any issues raised within its scope.

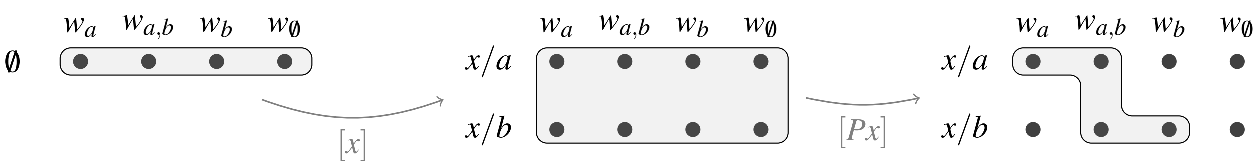


Figure 2: The two-step update effect of $\exists xPx$.

Figure 3: The update effect of a disjunctive sentence, $Pa \vee Pb$.

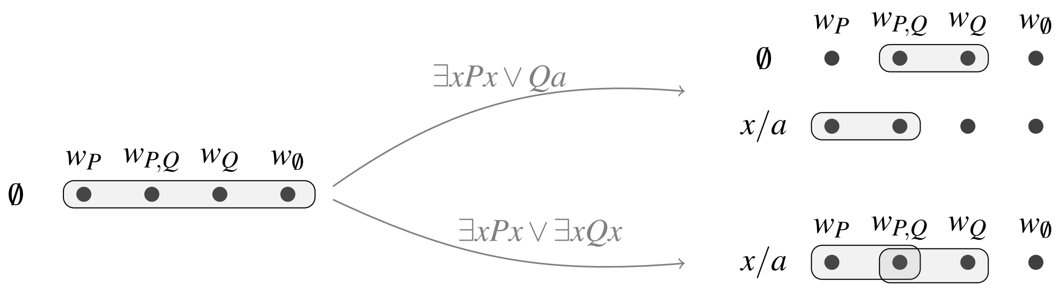


Figure 4: Update effect of $\exists xPx \vee \exists xQx$ and $\exists xPx \vee Qa$ on $C_\top$. For this example, it is assumed that D has only one element, a. w_P is a world in which a has property P but not Q, w_Q a world in which a has property Q but not P, and similarly for $w_{P,Q}$ and $w_\emptyset$.

(10) Bill either rented a^x car or hitchhiked. *It$_x$ was probably a cabriolet.

(11) Bill either rented a^x blue car or a^x red car. It$_x$ was probably a cabriolet.

This contrast is captured in $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$. To see this, consider the following two sentences in our logical language: $\exists xPx \vee Qa$ and $\exists xPx \vee \exists xQx$. The effects of updating the initial context with these two sentences are depicted in Fig. 4. In the case of $\exists xPx \vee Qa$, only the first disjunct introduces a new discourse referent, while in the case of $\exists xPx \vee \exists xQx$, both disjuncts introduce the same new discourse referent. This affects the binding potential of the two sentences. The discourse referent introduced by the first disjunct in $\exists xPx \vee Qa$ cannot be picked up by subsequent anaphora. For instance, a subsequent update with Qx would be undefined. However, the discourse referent introduced by both disjuncts in $\exists xPx \vee \exists xQx$ *can* be picked up by subsequent anaphora.

In general, if only one of the disjuncts, call it dis_1, introduces a discourse referent, this referent is not accessible outside of the disjunction, at least not immediately. However, if further updates confirm disjunct dis_1, then the discourse referent introduced by it does become accessible. This captures the felicity of the following mini-dialogue:

(12) **A:** Bill either rented a^x car or hitchhiked.
B: The former of course. It$_x$ was a cabriolet.

We will see that discourse referents introduced in polar questions behave similarly.

4.4. Raising issues about the identity of a discourse referent

We introduce a new operator, $?x$, which we intuitively understand as raising an issue about the identity of the discourse referent x. We refer to it as the *identification operator*. Formally, when $?x$ is applied to a context C, it reduces that context to a new context in which the possibilities in each state agree on the entity assigned to x.

(13) $C[?x] := \{ s \in C \mid \text{for all } \langle w,g\rangle, \langle w',g'\rangle \in s : g(x) = g'(x)\}$

An illustration is given in Fig. 5. Note that $?x$ ensures that states in the output context never include possibilities from two different rows in the diagram. Also note that the conjunction $\exists x Px \wedge ?x$ achieves, modulo the introduction of a new discourse referent, exactly what the inquisitive existential quantifier in $\mathsf{Inq_B}$ does: it raises an issue whose resolution requires establishing of some individual d that it has the property P. Thus, inquisitive existential quantification is decomposed in $\mathsf{Inq_B^D}$ into two operations: one which just introduces a discourse referent, and one which raises an issue about the identity of this discourse referent. We believe that this decomposition is useful in analyzing the semantics of wh-words and indefinites in natural languages, as will be illustrated in Sect. 5.

4.5. Discharging issues and discourse referents: negation

Our treatment of negation, given in (14), is very close to both GSV and $\mathsf{Inq_B}$.

(14) $C[\neg\varphi] = \{ s \in C \mid \text{no consistent state } t \subseteq s \text{ subsists in } C[\varphi]\}$

In computing $C[\neg\varphi]$ we first compute $C[\varphi]$. In this process new discourse referents may be introduced. However, the states that end up in $C[\neg\varphi]$ are ones that were already in C and which moreover have no consistent substate that subsists in $C[\varphi]$. So discourse referents that are introduced within the scope of a negation are disregarded outside of that scope. In other words, negation is 'externally static', as is standardly assumed in dynamic semantics. Moreover, as in $\mathsf{Inq_B}$, negation also discharges any issues that are raised within its scope. That is, even if φ is inquisitive, $\neg\varphi$ never is.

Let us illustrate this with a few examples: $\neg Pa$, $\neg(Pa \vee Pb)$ and $\neg\exists x Px$, see Fig. 6. Note that when the domain of the model only contains two atomic individuals, a and b, $\neg(Pa \vee Pb)$ and $\neg\exists x Px$ are equivalent, even though $Pa \vee Pb$ and $\exists x Px$ are not: only the former is inquisitive, and only the latter introduces a discourse referent. The equivalence of $\neg(Pa \vee Pb)$ and $\neg\exists x Px$ arises because negation discharges issues as well as discourse referents that are introduced within its scope.

One particular consequence of this is that the double negation of a sentence φ, $\neg\neg\varphi$, while always conveying exactly the same information as φ itself, never raises any issues and never introduces any discourse referents. This is illustrated in Fig. 6 for $\neg\neg(Pa \vee Pb)$ and $\neg\neg\exists x Px$ (compare with Fig. 2 and Fig. 3).

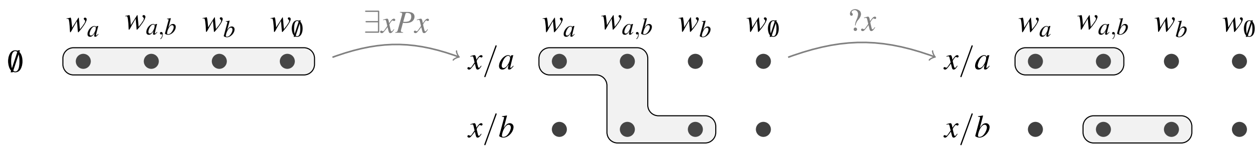


Figure 5: Update effect of $\exists x Px \wedge ?x$ on $C_\top$.

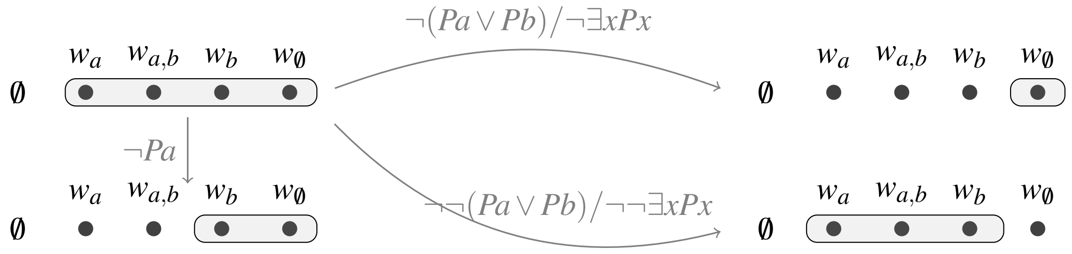


Figure 6: Update effect of $\neg Pa$, $\neg(Pa \vee Pb)$, $\neg\exists xPx$, $\neg\neg(Pa \vee Pb)$, $\neg\neg\exists xPx$ on $C_\top$.

4.6. Discharging issues while projecting discourse referents

$\mathsf{Inq_B}$ comes with a ! operator, which behaves just like double negation: when applied to a sentence φ, it discharges the issues raised by φ. That is, $!\varphi$ conveys the same information as φ itself but does not raise any issues. In $\mathsf{Inq_B^D}$, we define ! in such a way that it has these two properties as well. However, in this setting, unlike in $\mathsf{Inq_B}$, we also have a choice as to whether ! should be externally dynamic or static, i.e., as to whether the discourse referents introduced in its scope can be picked up outside by external anaphoric expressions or not. We define it in such a way that it is externally dynamic. Thus, ! differs from double negation in $\mathsf{Inq_B^D}$, while in $\mathsf{Inq_B}$ the two operations are indistinguishable. This choice is motivated by the fact that, as we will see in Sect. 5, sentences in English plausibly involve an operator which discharges inquisitiveness but is externally dynamic. We thus define the update effect of ! as follows:

(15) $C[!\varphi] = \{\, s' \in\, !C[\varphi] \mid s' \text{ is an extension of some } s \in C\}$

Let us break this down. First, every state s' in $C[!\varphi]$ must be an element of $!C[\varphi]$, the context that is obtained from C by updating with φ and then removing any open contextual issues. This means that s' has to support the information conveyed by φ, but does not need to resolve the issues that φ introduces. Crucially, however, s' still has to resolve the issues that were present in the old context C, the context preceding the update with φ. This is ensured by requiring that s' is an *extension* of some $s \in C$.

The workings of ! are illustrated in Fig. 7. On the left, we see that when ! is applied to an inquisitive disjunction, $Pa \vee Pb$, it eliminates inquisitiveness. In this case it has the same effect as double negation would have. On the other hand, when ! is applied to an existentially quantified sentence, $\exists xPx$, it does not eliminate the discourse referent that this sentence introduces. So in this case it behaves differently from double negation.

4.7. Ensuring inquisitiveness

Besides the ! operator, which eliminates inquisitiveness as we have just seen, $\mathsf{Inq_B}$ also comes with a ? operator, which *ensures inquisitiveness*. That is, when ? is applied to a sentence φ, the resulting sentence $?\varphi$ is always inquisitive (unless φ is a contradiction or a tautology, in which case $?\varphi$ is also a tautology). This is achieved in $\mathsf{Inq_B}$ by postulating that a state supports $?\varphi$ just in case it either supports φ or $\neg\varphi$. This means that $?\varphi$ is equivalent in $\mathsf{Inq_B}$ to the disjunction $\varphi \vee \neg\varphi$. We adopt this treatment of $?\varphi$ in $\mathsf{Inq_B^D}$:

(16) $C[?\varphi] := C[\varphi \vee \neg\varphi]$

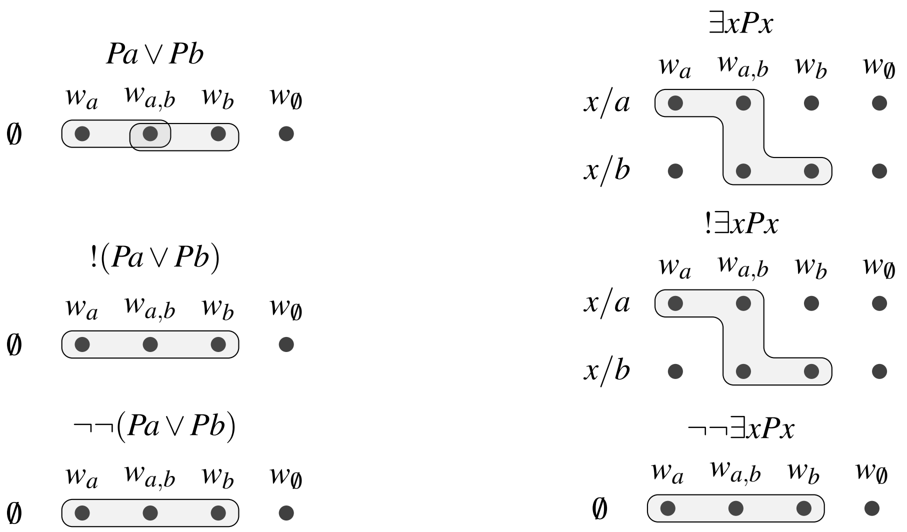


Figure 7: Workings of ! and double negation in $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$. Each subfigure shows the result of updating the initial context $C_\top$ with the given sentence.

4.8. Implication and universal quantification

In our treatment of implication and universal quantification we stay very close to GSV. For reasons of space, we cannot discuss or illustrate this treatment here in much detail. The update effect of an implication is given in (17).

(17) $C[\varphi \rightarrow \psi] = \{s \in C \mid \text{for all } t \subseteq s, \text{ all descendants of } t \text{ in } C[\varphi] \text{ subsist in } C[\varphi][\psi]\}$

In computing $C[\varphi \rightarrow \psi]$ we first compute $C[\varphi]$ and $C[\varphi][\psi]$. The states that end up in $C[\varphi \rightarrow \psi]$ are ones that are already in C and moreover have no substate which has a descendant in $C[\varphi]$ that fails to subsist in $C[\varphi][\psi]$. Thus, implications are externally static, just like negated sentences. However, just like in Inq_B, implication does project inquisitiveness. In particular, if the consequent of an implication is inquisitive, the implication as a whole is typically inquisitive as well (unless the antecedent resolves the issue expressed by the consequent).

The update effect of a universally quantified sentence is given in (18).[8]

(18) $C[\forall x\varphi] = \{s \in C \mid \text{for all } t \subseteq s, \text{ all descendants of } t \text{ in } C[x] \text{ subsist in } C[x][\varphi]\}$

Just like implication, universal quantification is externally static but projects inquisitiveness. Moreover, the equivalence in (19) holds, as is common in dynamic semantics.

(19) $C[\forall x\varphi] = C[\exists x\top \rightarrow \varphi]$

5. Illustrations

We will now briefly illustrate how $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$ can be used to analyze declarative and interrogative sentences in English, paying particular attention to certain non-trivial interactions between anaphora and inquisitiveness.

[8]The universal quantier as defined here and in GSV is an example of an unselective quantifier (cf. Kadmon, 1987; Heim, 1990; Brasoveanu and Dotlačil, 2016 for discussion). This approach would not be desirable if we want to go beyond universal quantification and define generalized quantifiers, but it is sufficient for our purposes here.

We make three assumptions about how English sentences are translated into our logical language. First, we assume that declarative and interrogative sentences consist of a TP clause as well as a number of syntactic heads in the left periphery (see, e.g., Rizzi, 1997), and that in both sentence types ! applies to the TP clause, discharging any issues that are raised within its scope (as proposed and motivated in some detail in Roelofsen and Farkas, 2015; Farkas and Roelofsen, 2017). Second, we propose that the interpretation of both indefinites and wh-phrases involves (i) an existential quantifier, which introduces a discourse referent, and (ii) an identification operator, which raises an issue about the identity of this discourse referent. The difference is that in the case of indefinites, the identification operator enters the semantic composition locally, within the TP clause boundary, while in the case of a wh-phrase, the identification operator scopes above the ! operator that closes off the TP clause (this proposal can be made more precise in terms of Agreement between wh-phrases and an operator in the left periphery). This captures the fact that issues raised by wh-phrases about the identity of the discourse referents that they introduce, unlike those raised by indefinites, surface in the overall interpretation of the containing sentence and need to be addressed in the proceeding discourse. Our last assumption concerns polar questions: we assume that such questions involve a ? operator, which is introduced in the left periphery above !.[9]

We will first illustrate these assumptions with three simple examples. After that, we will turn to somewhat more complex cases involving anaphora.

First consider the simple declarative sentence in (20), which contains an indefinite. The presence of the ! operator in the translation follows from our first assumption above, and the translation of the indefinite as an existential quantifier followed by the identification operator follows from our second assumption.

(20) A man left. $\rightsquigarrow$ $!\exists x(?x \wedge Mx \wedge Lx)$

Suppose that (20) is uttered in a non-inquisitive context which does not have x in its domain. Then, the output context is still non-inquisitive, but has x as an active discourse referent. The context contains one maximal state, consisting of all possibilities $\langle w, g \rangle$ which are extensions of a possibility in the input context and which are such that $[x]^g$ is a man that left in w. This captures the intuitively correct meaning of the sentence, including the fact that (20) does not raise an issue that has to be resolved but does introduce a discourse referent that can be picked up in the subsequent discourse.

Now consider the simple wh-question in (21). The presence of the ! operator in the translation follows from our first assumption, and the fact that the identification operator appears outside its scope follows from our second assumption.

(21) Which man left? $\rightsquigarrow$ $!\exists x(Mx \wedge Lx) \wedge ?x$

This question introduces a discourse referent x, conveys that x is a man who left, and then raises an issue about the identity of x, i.e., it asks who x is. The ! operator is vacuous in (21) since its scope is non-inquisitive (see Sect. 4.6). However, it is non-vacuous in wh-questions which, besides wh-phrases, host other inquisitive elements as well (see also Champollion et al.,

[9] This last assumption suffices for our purposes here, but needs to be refined in order to deal with alternative questions. We are hopeful that the analysis of such questions in $\mathsf{Inq_B}$ (see, e.g., Roelofsen and Farkas, 2015; Roelofsen, 2015) can be transferred to $\mathsf{Inq_B^D}$, but must leave this for future work.

2017). For example, (22) introduces a discourse referent x, conveys that x is a man who sang or danced, and asks who x is. Crucially, a proper answer to this question does not need to resolve whether x sang or whether x danced, it only needs to resolve the identity of x. This is correctly captured.

(22) Which man sang or danced? $\rightsquigarrow$ $!\exists x(Mx \wedge (Sx \vee Dx)) \wedge ?x$

Given our current assumptions, we derive non-exhaustive interpretations for wh-questions. To see this, consider (21) again. It is predicted that this question can be resolved by identitying just one man who left. It is not necessary to identify all men who left. In inquisitive semantics, it is common to view non-exhaustive question interpretations as basic, and to derive exhaustive interpretations by means of an additional operation in the composition process (see, e.g., Theiler, 2014; Champollion et al., 2017). Explicitly incorporating such an operator into $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$ is left for future work.

We now turn to cases involving anaphora. In (23), the indefinite in the first sentence introduces a discourse referent, and the pronoun in the second sentence refers back to it. Since ! projects discourse referents introduced in its scope and conjunctions are dynamic, we correctly predict that this case of anaphora is licensed.

(23) A^x man left. He$_x$ was angry. $\rightsquigarrow$ $!\exists x(?x \wedge Mx \wedge Lx) \wedge !Ax$

A parallel question-answer pair is given in (24). As long as the input context allows for the possibility that more than one man left, the question will lead to an inquisitive output context. Crucially, both $?x$ and Ax can pick up the discourse referent introduced by the existential quantifier because no operator blocks the projection of discourse referents, just as in (23).

(24) **A:** Which^x man left?
B: (I don't know but) he$_x$ was angry.
$\rightsquigarrow$ $!\exists x(Mx \wedge Lx) \wedge ?x \wedge !Ax$

Now consider the more complex case in (25), involving a sequence of two questions.

(25) Which^x man read a^y book? And did he$_x$ like it$_y$?
$\rightsquigarrow$ $!\exists x \exists y(Mx \wedge By \wedge Rxy) \wedge ?x \wedge ?!Lxy$

Suppose that the input context is non-inquisitive, there are two men, Adam and Bill, two books that could be read, and it is unknown who read what and who liked what. Then the output context contains four alternatives, corresponding to 'Adam read a book and he liked it', 'Adam read a book and he did not like it', 'Bill read a book and he liked it', and 'Bill read a book and he did not like it'. Crucially, $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$ allows us to capture the fact that the dependency between x and y created in the first question is anaphorically accessed in the second question.

The system can also deal with conditional questions involving donkey anaphora, as exemplified in (26). In the translation, we assume that the antecedent of the conditional is not closed off by the ! operator (for independent evidence that inquisitiveness is not discharged in conditional antecedents, see Ciardelli et al., 2018).

(26) If a^x farmer owns a^y donkey, does he$_x$ beat it$_y$?
$\rightsquigarrow$ $\exists x \exists y(?x \wedge ?y \wedge Fx \wedge Dy \wedge Oxy) \rightarrow ?!Bxy$

Suppose that the input context is non-inquisitive, there are two farmers, Adam and Bill, two donkeys, d_1 and d_2, and it is unclear who owns and beats what. Then, it is predicted that the question leads to an output context containing two alternatives, one corresponding to the positive response 'yes, farmers beat the donkeys they own' and one to the negative response 'no, farmers don't beat the donkeys they own'. Crucially, the discourse referents introduced by the indefinites in the conditional antecedent can be picked up by the pronouns in the consequent. As far as we know, this is the first account of donkey anaphora in conditional questions. As mentioned above, earlier dynamic semantic theories of questions that capture basic anaphoric patterns (Groenendijk, 1998; van Rooij, 1998; Haida, 2007) are built on partition semantics, and conditional questions are not within the immediate reach of partition semantics. Isaacs and Rawlins (2008) do provide an account of conditional questions in a partition semantics extended with hypothetical updates. However, their theory does not account for anaphora.

Finally, $\mathsf{Inq}_\mathsf{B}^\mathsf{D}$ also allows us to capture the fact that indefinites in polar questions can license subsequent anaphora, though only to a limited extent. To see this, consider (27).

(27) Do you see a^x man?

$\rightsquigarrow$ $?!\exists x(?x \wedge Mx \wedge Syx)$

$=$ $!\exists x(?x \wedge Mx \wedge Syx) \vee \neg!\exists x(?x \wedge Mx \wedge Syx)$

Suppose that this question is uttered in the initial context. Then, given the interpretation of disjunction (see Sect. 4.3) the output context contains information states contributed by an update with the first disjunct, as well as information states contributed by an update with the second disjunct. Only the former will consist of possibilities that assign a value to x. Since a subsequent update is well-defined only if all the terms in the sentence receive an interpretation in all the states in the context, we predict that the question in (27) on its own does not license anaphora to the indefinite *a man*. However, when the question is resolved affirmatively, states that were contributed by the update with the second disjunct are eliminated, and the discourse referent introduced by the indefinite should become accessible. On the other hand, resolving the question negatively should block anaphora. These predictions are correct, as shown in (28).

(28) a. **A:** Do you see a^x man? **B:** Yes, he$_x$ is behind the tree.
b. **A:** Do you see a^x man? **B:** #No, he$_x$ is behind the tree.

The fact that indefinites inside polar questions can license anaphora, as in (28), is particularly problematic for Haida (2007), who has to treat polar questions as externally static. Other existing dynamic accounts of anaphora in questions, van Rooij (1998) and Groenendijk (1998), do not account for this phenomenon either but may possibly be extended to do so. In particular, Groenendijk (1998) suggests that in cases like (29), the binding possibilities of the indefinite may be captured by the same mechanism that is used to capture modal subordination.

(29) Did you see a^x man? And was he$_x$ angry?

The question operator, ?, would be present in both questions. We could assume, then, that the context created under the first ? operator might be accessible for the second ? operator, as a form of subordination. This strategy, however, does not work for (28).

6. Conclusion

We have presented a basic dynamic inquisitive semantic framework, $\mathsf{Inq}_{\mathsf{B}}^{\mathsf{D}}$, and illustrated its potential to capture certain non-trivial interactions between anaphora and inquisitiveness in English. Unlike previous dynamic accounts of questions and anaphora (Groenendijk, 1998; van Rooij, 1998; Haida, 2007), $\mathsf{Inq}_{\mathsf{B}}^{\mathsf{D}}$ can straightforwardly derive non-exhaustive question interpretations and deal with conditional questions, just like its static counterpart $\mathsf{Inq}_{\mathsf{B}}$. In ongoing work, we are exploring further potential benefits of a dynamic inquisitive approach to questions. In particular, we are pursuing an account of intervention effects and of the cross-linguistic morphological affinity between wh-words and indefinites (both previously analyzed by Haida, 2007 in a dynamic partition theory of questions).

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Self-addressed questions and indexicality — The case of Korean[1]

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Abstract. Korean questions are marked as true questions (with final particle *ni*) or self addressed questions (SAQ, henceforth) (with final *na/ka*). SAQ are characterized as "uttered in the absence of addressee" in the literature. We argue in favour of a more detailed pragmatic profile, as SAQ can be uttered in the presence of other persons and can contain second person pronouns 'you' that refer to these. SAQ in Korean are however incompatible with the performative honorific *upni* (Jang and Kim, 1998). We propose that Korean refers to contexts with *bystanders* in addition to *speaker* and *addressee.* SAQ require that *sp*(*c*)=*ad*(*c*), and prohibit *upni* because the speaker cannot honorify herself. Second person 'you' refers to the most salient bystander, which can differ from *ad*(*c*) in SAQ. The account extends to theme-setting questions and other data.

Keywords: honorifics, second person pronouns, theme-setting questions, context, indexicals.

1. Introduction

What is a self-addressed question? While *any* question can be self-addressed if the speaker utters it in the absence of other persons, many languages offer special lexical means to indicate that a question is self-addressed. Self-addressed questions do not request an answer from anyone, the speaker seems to deliberate rather than ask, or the speaker asks herself rather than others. Case studies in the literature include SAQ in Salish languages (Littell et al., 2010, calling them *conjectural questions*), German questions with verb-end syntax and particle *wohl* (Thurmair, 1989; Truckenbrodt, 2006; Zimmermann, 2008, 2013), Italian questions in the evidential future (Mari, 2010; Eckardt and Beltrama, 2019), Japanese *daroo* questions (Hara, 2018) and more (see San Roque et al., 2017). The present paper investigates SAQ in Korean. Korean questions are marked as true questions with the particle *-ni*. Question particles are obligatory in polar questions but can sometimes be omitted in *wh*-questions. We will systematically use question particles in our data. (1) is a true question.

(1) Mary-ka o-ass ni?
Mary-NOM come-PAST trueQ
'Has Mary come?'

Questions can alternatively be marked as self-addressed questions with the particles *na* or *ka.* While these are not freely interchangeable, speakers report that their pragmatic impact is the same. Example (2) shows a SAQ with the particle *-na*.

(2) Mary-ka o-ass na?
Mary-NOM come-PAST SAQ
'Has Mary come, I wonder.'

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The observation was first discussed in (Jang and Kim, 1998; Jang, 1999) on basis of (1), (2) and similar examples. They describe questions with *na/ka* as "usually used in a monologe" or "in absence of an interlocutor". While we agree that SAQ can be used under these circumstances we argue in favour of a more differentiated pragmatic profile. The present paper is structured as follows. Section 2 surveys data discussed by Jang and Kim (1998), in particular the interaction of SAQ markers and the performative honorific *upni* in Korean. We criticize Jang and Kim's (1998) prediction that second person pronouns are degraded in SAQ. New data in section 3 illustrate the use of SAQ *na* in contexts where other speakers are present, and its interaction with honorifics and the use of second person pronouns. Section 4 presents our formal account for Korean SAQ. In essence we propose that utterance contexts *c* in Korean define not only the usual parameters *speaker, addressee, time, place* and *world* but in addition the set of *bystanders*. SAQ markers and honorifics impose restrictions on context. The account can successfully explain the data, as we survey in 5.1. It is further corroborated by theme-setting questions (5.2) and true questions asked to self (5.3). Section 6 lists earlier analyses of SAQ in other languages, specifically Speas and Tenny (2003), Truckenbrodt (2006), Littell et al. (2010), Farkas and Bruce (2010) and Farkas (2018) as well as Eckardt and Beltrama (2019). We argue that they cannot easily account for honorifics in true questions vs. SAQ in Korean whereas our Neo-Kaplanian analysis offers a better starting point to understand the case.

2. Korean SAQ and true Q

Korean questions are marked as true questions or self-addressed questions (SAQ) by different question particles, as shown in (1), (2) above.[2] Korean also uses honorific markers and Jang and Kim report that SAQ interact with honorification in an interesting way (Jang and Kim, 1998; Jang, 1999). The bound honorific morpheme *upni* must be used in an utterance when the speaker is socially lower than the addressee. Example (3) shows a question addressed to a socially higher person. As (4) shows the use of *upni* is blocked in SAQ questions with *na/ka*.

(3) Mary-ka o -ass -upni -kka?
Mary-NOM come -PAST -HON -true Q
'Has Mary come?' (addressing a higher person)

(4) *Mary-ka o -ass -upni -ka/na? (Jang and Kim, 1998:195)
Mary-Nom come -PAST -HON -SAQ
unavailable: 'Has Mary come I wonder.'

According to the authors' intuition, *-ka/-na* indicates that the question is asked in the absence of an interlocutor. They propose that in SAQ, the speaker addresses himself and hence $sp(c) = ad(c)$. Given that the speaker is not socially higher than himself, this can explain the prohibition against *upni* in SAQ.

Jang and Kim point out that the proposal is supported by the *Genius* examples in (5)/(6) where SAQ markers interact with the use of second person *ne(-ka)* 'you' (Jang and Kim, 1998:195f). Speaker A can ask (5) addressing self. In contrast, A cannot ask (6) in the presence of a second person B.

[2] Speakers prefer *na* or *ka* in different examples. The choice seems to rest on morphophonological factors and we do not aim to capture these preferences. We double-checked all uses of particles and the glossing as SAQ marker vs. trueQ marker with native informants.

(5) *The Genius example* (first person)
nay-ka chencay -i -n -ka?
I-NOM genius -be -PRESENT -SAQ
'Am I a genius, I wonder.'

(6) *The Genius example* (second person)
*ne-ka chencay -i -n -ka?
you-NOM genius -be -PRESENT -SAQ
unavailable: 'Are you a genius, I wonder.'

Jang and Kim thus take (6) as further evidence in favour of the assumption that SAQ contexts are contexts where *sp*(*c*) = *ad*(*c*). While speaker-addressee-identity is unproblematic for the first person pronoun *nay,* it interferes with the interpretation of second person *ne*: second person pronouns denote the addressee. If we furthermore presuppose that the referent of second person *ne* must differ from the speaker we predict that (6) imposes inconsistent requirements on the context where *sp*(*c*) = *ad*(*c*).
However, as Jang and Kim point out, their diagnosis is challenged by the following observation.

(7) *The Genius example* (past)
?ne-ka chencay -i -ess -ten -ka? (Jang and Kim 1998: 197)
you-NOM genius -be -PAST -Recoll -SAQ
'Were you a genius? (conjecture)'

While (7) is still slightly marked the authors report that the change from present to past tense significantly improves the example. This effect is unexpected, as the change in tense does not have any influence on the protagonists in context. Jang and Kim tentatively suggest that past tense allows to dissociate the present addressee B_{now} from its younger self B_{past}. This, they propose, allows to dissociate the referent of 'you' from the addressee and hence allows *ne* to refer to B_{past} while the context remains one where *sp*(*c*) = *ad*(*c*).

We argue that their account of (7) is inadequate as the proposed distinction of B_{now} / B_{past} does not resolve the puzzle posed by (7). They assume that (7) has a self-addressing context *c* where *sp*(*c*) = *ad*(*c*). The real physical situation includes A (speaker) and B (other person). If we follow Kaplan's classical analysis of indexicals, the second person pronoun *ne-* should refer to *ad*(*c*) (Kaplan, 1989). Hence (7) should be tantamount to the question "Is A a genius?". This prediction is simply false, and the steps in the analysis are not affected by the fact that B has two identities B_{now} vs. B_{past}. The puzzle remains. If Jang and Kim want to claim that *ne* 'you' can possibly refer to an individual who is not the addressee in *c*—*pace* traditional Kaplan—it is unclear why this should be facilitated by the fact that the referent of *ne* is coming in two different identities B_{now} and B_{past}.
We hence conclude that Jang and Kim's tentative remarks are insufficient to solve the puzzle posed by (7). In the next section, we survey more examples in order to see how the referent of *ne* ('you') and *ad*(*c*) are related.

3. More evidence on Korean SAQ

Jang and Kim describe *na* as a question particle indicating that Q is asked in the absence of an interlocutor. A closer look reveals that this description is too simple. Imagine a situation where

A and B are standing in front of A's house. A is searching bags and pockets for the key. According to our informants, A can utter either the true question (8a) or the SAQ (8b) in the given situation.

(8) *The Key example*
a. yelsoy-ka eti(-ey) iss -ni?
key-NOM where(-LOC) exist -trueQ?
'Where is the key?'
b. yelsoy-ka eti(-ey) iss -na?
key-NOM where(-LOC) exist -SAQ?
'Where is the key, I wonder.

A will preferably utter (8a) iff A believes that B might know the answer. A will preferably utter (8b) iff A doesn't believe that B can provide the answer and does not request B to answer. Yet, A may intend B to hear the utterance; for instance to inform B why the door is still locked.

We must hence distinguish between the presence/absence of a second person and the fact whether the second person is addressed in the sense relevant for true questions. The presence of second persons becomes linguistically relevant when A uses a second person pronoun *ne*. Consider the following situation: A is visiting B at her home. They watch a van from the local flower shop arriving in front of B's house. B is surprised. A comments:

(9) *The Fleurop example*
ne-ka kkochtapal-ul pat -ullye -na?
you-NOM flowers-ACC receive -MOD.POSS -SAQ?
'Will you perhaps get flowers, I wonder.'

Like in (8b), A doesn't believe that B can answer and does not request B to answer. Nevertheless A can use a second person pronoun *ne* to refer to B. Our informants report that (9) sounds conjectural, but we will leave this nuance aside. The use of honorific *upni* is still unacceptable in (9). This judgment was not influenced by the social ranking between A and B. The *Fleurop* example challenges simple conclusions that we might draw from the *Genius* example in (6). Example (6) doesn't show that second person pronouns in SAQ are generally unacceptable. If that were the case, (9) should likewise be unacceptable, which it is not.

Further probing of the *Genius* example revealed that it improves in situations where the referent of *ne* 'you' cannot possibly answer the question. Imagine that A studies the photo/ picture of a PhD applicant. The person is not present and thus cannot possibly answer A's question.

(10) *The Photo example*
$^{?}$ne-ka chencay -i -n -ka?
you-NOM genius -be -PRES -SAQ
'Are you a genius I wonder.'

(10) was judged to be slightly marked but overall acceptable. Similar situations were likewise classed as marked but acceptable, for instance if A is looking at a trained (but non-speaking) dog, or if A is looking at a baby—the offspring of two nobel prize winners—who cannot speak yet. In summary, second person pronouns in SAQ are permitted when *ne* ('you') refers to a non-speaking entity or a human who is not able to answer and hence not requested to answer.

We conclude that the *Genius* question (6) in the given situation must violate more subtle restrictions imposed by SAQ and will return to the example in Section 5.1 after having presented our analysis.

4. Analysis

Section 4 introduces the elements of our analysis. In 4.1 and 4.2 we argue that Korean utterance contexts make use of the parameter of *bystanders* and show how the addressee of a question can be dissociated from the referent of second person *ne* 'you'. In 4.3 we refine Jang and Kim's semantics of the SAQ markers *na* and *ka*. 4.4 treats honorific *upni*.

4.1. Korean context

Following (Kaplan, 1989), utterance situations in the real world are modeled by contexts *c*. These are mapped to speaker, addressee, time, place etc. by functions *sp, ad, time, place* and thus provide the persons and parameters necessary to determine the meaning of indexicals. Korean examples like the *Key* example, repeated below, show that contexts are not fully determined by the real-world utterance situation. Context *c* also depends on the speaker's intentions. Whether a bystander B is conceived as addressee or not depends on the intentions of speaker A. Hence the same physical situation allows for both the SAQ and true Q version of (11).

(11) *A and B in front of A's house, A searching for key.*

yelsoy-ka	eti(-ey)	iss-na?/	ni?
key-NOM	where(-LOC)	exist-SAQ? /	-trueQ?

When asking the *-ni* question A intends that *ad*(*c*) = B. By attributing the role of addressee to B, A signals 'I want B to answer the question' and 'I believe that B might know the answer'.[3] In this context B is requested to react by answering. When asking the *-na* question in (11), A construes a context where *ad*(*c*) = *sp*(*c*) (see 4.3.). Other persons B may be present but A does not pose any requests to B. We leave it open whether A requests A to do anything; to our intuition this is not the case.

For Korean, we model the *bystanders* in context with a function *by*: *c* → X, where X is a set of persons who count as bystanders in *c*.[4] Example (8b), for instance, includes B as a bystander; B is physically close to the speaker and able to hear the utterance. Bystanders who are not the addressee *ad*(*c*) do not undertake the obligations of the addressee; specifically, they do not have to answer to questions.

Finally, we propose that one of the bystanders can be identified as the most salient bystander by the speaker. Addressee and bystanders are related in the following ways:

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[3] A tempting default for contexts *c* could be: *sp*(*c*) ≠ *ad*(*c*) and the speaker requests the addressee to react in standard ways to major speech acts: *update belief* in reaction to assertions; *answer* to questions and *obey* to imperatives. In view of the many counterexamples in the literature we refrain from this strong assumption. More research would be needed to understand how the default can be overwritten.

[4] *by*(*c*) = Ø is possible.

(12) a. The speaker $sp(c)$ is never a bystander: $sp(c) \notin by(c)$.
b. If possible, $ad(c) \in by(c)$.
c. If $ad(c) \in by(c)$ then ad(c) counts as the most salient bystander.

These assumptions will allow us to give a uniform semantics for the Korean second person pronoun *ne* in section 4.2.

While it is normally assumed that the utterance context is more or less determined by the physical situation of utterance, our proposal is not the first one to give up this assumption. Von Fintel and Gillies (2010) point out the possibility to construe different sets of persons as 'the speaker(s) in *c*' in their analysis of English epistemic *might.* In a similar vein, the present study probes the relation between physical utterance situation and the addressee parameter of context.

4.2. Second person *ne-ka* 'you.NOM'

We turn to the interpretation of *ne* 'you'. Kaplan's (1989) interpretation of indexicals would predict that Korean second person $[[\ ne\ ]]^c = ad(c)$. The data suggest that we have to modify this analysis. We propose that the referent of *ne* is the most salient bystander B in $by(c)$.

(13) $[[\ ne\ ]]^c = B$ for the most salient bystander B in $by(c)$.

This definition interacts with the assumptions in 4.1. as follows. If $sp(c) \neq ad(c)$, then $ad(c) \in by(c)$ and $ad(c)$ counts as the most salient bystander. Assumptions (12b,c) hence entail that *ne* in the normal case refers to $ad(c)$, like Kaplan's analysis would have it. If however $sp(c) = ad(c)$, the addressee is not in $by(c)$ due to assumption (12a). In this case, *ne* refers to the most salient bystander and this referent does not count as the addressee in *c*. Example (8b) can serve as a first illustration of a context *c* where B is a bystander but not the addressee. Note that assumption (12a) generalizes Kaplan's presupposition that second person pronouns never refer to the speaker (Schlenker, 2018). The analysis dissociates the referent of *ne* 'you' and the addressee $ad(c)$ and thus allows us to deal with the data in section 2 and 3.

4.3. *ka/na* and context

We assume that the self-addressed question particle *na/ka* in Korean questions imposes a restriction on the context of utterance. Jang and Kim's core idea remains one prominent factor of its meaning.

(14) $[[\ \text{-}na/ka\ ]]^c$ is defined in context *c* iff $sp(c) = ad(c)$
If $by(c) \neq \emptyset$ then *na/ka* presupposes that
1. Ignorance/Inability: $sp(c)$ believes that no x in $by(c)$ can answer Q.
2. Release: $sp(c)$ does not request any $B \in by(c)$ to answer Q.
If defined, $[[\ \text{-}na/ka\ ]]^c = \lambda Q_{\langle\langle s,t\rangle,t\rangle}.Q$

As a first consequence, *-na/ka* allows questions in situations where no other person is present and the speaker is practically forced to adopt $sp(c) = ad(c)$. The definition accounts for the intuition voiced by Jang and Kim that the speaker seems to talk to herself. Under which additional circumstances are *-na/ka* questions possible in the presence of other persons B? (14)

limits such questions to contexts where the speaker doesn't think that B can answer the question and doesn't request that B should answer. These specific restrictions serve to distinguish SAQ from certain true questions (see 5.1) and are necessary to explain the *Genius* example in (6).

4.4. Honorofic *upni*

Let again be *c* the utterance context, *sp(c)* the speaker in *c*, *ad*(*c*) the addressee in *c*. For the sake of simplicity we will assume that the honorific morpheme *upni* takes scope over the entire sentence. The use of *upni* in sentence *S* limits the contexts *c* in which *upni* S can be uttered.

(15) $[[\ \textit{upni}\ \mathrm{S}\ ]]^{c} = [[\ S\ ]]^{c}$ iff *sp*(*c*) is strictly socially inferior to *ad*(*c*)
$[[\ \textit{upni}\ S\ ]]^{c} = *$ undefined otherwise.

We acknowledge that this proposal does not attempt to do justice to the factors that determine social hierarchy. In many cultures "socially inferior" is a multi-factorial concept and the simplifying assumption that individuals are linearly ordered in social strata is not justified (see e.g., McCready, 2014 on Thai). We disregard the cultural issue whether *upni* defines a partial linear order on any given group of speakers. We assume however that "strictly socially inferior" is not a reflexive relation and that, consequently, no individual *a* can be strictly socially inferior to *a*. This is consistent with the analysis of *upni* as a performative honorific in Korean (Kim and Sells, 2007) and echoes the proposal in Jang and Kim (1998).

5. Predictions and further corroborating evidence

5.1. Predictions

Before looking into the data we would like to clarify our aims. We are only interested in those aspects of meaning that determine whether a question is a true question or SAQ. We ignore further semantic contributions of question particles, such as turning a denotation of type <s,t> (declarative) into type <<s,t>,t> (question). We likewise leave it open how and why question particles are restricted to questions.[5] This having been said, we will now return to our examples.

Examples (1) and (2) illustrate the basic distinction between true questions and self-addressed questions. According to our analysis, *na* in (2) restricts the possible uses of (2) to contexts *c* where *sp*(*c*) = *ad*(*c*), thus suspending all possible requests by the speaker to others. Likewise, the speaker does not request herself to answer. Whether *sp*(*c*) expects other reactions of bystanders or not will be determined by context, see 5.2. The denotation of *na* in (14) rests on the assumption that the semantic argument is already a question (type <<s,t>,t>). We thus dissociate question formation from *na* as pragmatic marker. Our meaning component can be combined with other possible semantic effects of *na*, for instance turning a proposition into a polar question. These may be shared by the complementary trueQ particle *ni* and its allomorphes. TrueQ marking *ni* does not pose restrictions on *c*. We assume that contexts of communication have distinct speaker and addressee by default. The speech act of (canonical) questioning where *sp*(*c*) ≠ *ad*(*c*) conveys that the speaker requests the addressee to answer. Cases like exam questions or questions to the culprit in (16) show that the speaker does not always expect that the addressee can answer, so this should not be a requirement of *ni.*

[5] See Jang and Kim (1998) for the interaction of particles and indefinites/question pronouns in Korean.

(16) *B took the key yesterday night; today it is missing.*
A interrogates B, suspecting that B lost it and has no idea where it is.
yelsoy-ka eti(-ey) iss-ni?
key-NOM where(-LOC) exist-trueQ?
'Where is the key?'

We leave it open whether all questions are united by the speaker's desire that the CG be updated by the answer (Truckenbrodt, 2006). Again, such proposals are compatible with the present account but require further testing.

The account can successfully predict the conflict between SAQ *na* and honorific *upni* in (3)/(4), repeated below.

(3) Mary-ka o -ass -upni -kka?
Mary-NOM come -PAST -HON -true Q
'Has Mary come?' (addressing a higher person)
(4) *Mary-ka o -ass -upni -ka/na?
Mary-NOM come -PAST -HON -SAQ
unavailable: 'Has Mary come I wonder.'

The performative honorific *upni S* restricts the possible utterance contexts *c* to those where the speaker is strictly socially inferior to the addressee. SAQ questions with *ka/na* are only defined in *c* if $sp(c) = ad(c)$. Given that no person *x* can be strictly superior to *x* themselves, there is no possible context *c* in which (4) can felicitously be uttered. Interestingly, the pragmatic contradiction translates into native speakers' judgment that (4) is ungrammatical.[6]

The *Key example* in (8a,b) is likewise accounted for by the present analysis. Korean contexts are sufficiently rich to allow for a bystander B who is not the addressee. In the trueQ (8a) the speaker construes the physical situation as a context where B is the addressee: $A \neq ad(c) = B$. A therefore requests B to answer the question; in the given situation we may infer further beliefs of A like, A believes that B might know where the key is. Examples like (16) show that this is not necessarily part of the meaning of the question. In the SAQ, (8b) the speaker construes the situation as one where A is also the addressee and B is thus under no obligations. We propose that B figures as a bystander in (8b) even though the sentence itself does not include any items that refer to B.

Matters are different in this respect in examples *Fleurop* (9) and *Photo talk* (10). The questions are marked with *na* and thus require a context *c* where $sp(c) = ad(c)$. According to 4.2 we have $ad(c) \notin by(c)$. The pronoun *ne* 'you' in this context refers to the most prominent *bystander* and we may assume that B figures as the most salient bystander. Yet B is not the addressee and therefore does not adopt the obligations of addressee in a true question. In other words, B is not requested or expected to answer. This is what characterizes the *Fleurop* example as well as the acceptable versions of the *Genius* example.

Finally turn to Jang and Kim's original *Genius* example repeated below.

[6] The case resembles pragmatic accounts of unlicensed use of NPIs. (Krifka, 1995; Kadmon and Landman, 1995) make a similar case for ungrammatical NPIs due to contradictory pragmatic content.

(6) *The Genius example* (second person)
*ne-ka chencay -i -n -ka?
you-NOM genius -be -PRESENT-SAQ
unavailable: 'Are you a genius, I wonder.'

We suspect that Jang and Kim rated the example as "ungrammatical" because they found it difficult to conceive of a context *c* where A= *sp*(*c*) encounters bystander B and believes that B is not able to answer this particular question. Our analysis assumes that using *ka*, the speaker believes that no bystander can answer the question. We therefore predict that A can not construe B as a bystander and the utterance in (6) causes a clash.

We can also host Jang and Kim's intuition that the past tense version of (6) is more acceptable. Imagine that A and B consider B's past self, wondering whether strange habits might in fact have been early signals of genius. In this situation A can grant B ignorance about his former self, which echoes Jang and Kim's intuition that the distinction between B_{now} and B_{past} is crucial for the case. While the observation made no sense in their original analysis it can explain the effect in the present account.[7] Our account allows A to construe B as a *bystander* who can be addressed with *ne* in a SAQ.

The following data supports our proposal that SAQ can only be asked when A believes that B does not know the answer. According to our informants (17) is only possibly if A deliberately and almost offensively ignores B.

(17) *The Quiz Game example*
A and B take part in a quiz game where A has to guess B's fake personality. B impersonates Einstein and has already given A some clues. A, talking to himself:
#ne-ka mwullihakca -i -n -ka?
you-NOM physicist -be -PRESENT-SAQ
unavailable/offensive: 'Are you a physicist, I ask myself-but-not-you.'

This shows that the SAQ marker *ka* does more than release B from the obligation to answer. It also requires a context where A believes that B cannot answer Q, be it due to ignorance, be it for other reasons.

5.2. Further corroboration: Theme-setting questions

While our analysis primarily aimed at self-addressing questions, it can account for more questions that match the criteria in (14). Consider a context where speaker A opens a lecture on astronomy with a theme-setting question: "How does a solar eclipse arise?". Obviously A does not request the audience to answer and neither believes that the audience can answer. And indeed, theme-setting questions in Korean are marked with *na.*

(18) ilsik-un ettehkey sayngki -na?
solar.eclipse-TOP how arise -SAQ
'How does an eclipse arise?' (theme-setting question)

[7] We are aware of the paradox inherent in the *Genius* examples: While A can be unaware of his own genius in (5) he presupposes B's full knowledge in (6). We leave these tangles of human modesty and self-awareness unexplored.

According to our account, [[*na*]] imposes the following restrictions on context *c*.

(14) [[*-na/ka*]]^c is defined in context *c* iff *sp*(*c*) = *ad*(*c*)
If *by*(*c*) ≠ Ø then *na/ka* presupposes that
1. Ignorance/inability: *sp*(*c*) believes that no *x* in *by*(*c*) can answer Q.
2. Release: *sp*(*c*) does not request any B ∈ *by*(*c*) to answer Q.

We propose that the speaker in (18) construes context *c* with the audience as bystanders and himself the addressee. The speaker does not expect the audience to be able to answer and does not request the audience to answer. Our analysis predicts that *na* is allowed in this context.

We moreover predict that second person pronouns can be used in theme-setting questions like *How do you become a millionaire in 5 years?* and refer to the audience. This prediction is difficult to test as Korean has subject and object pro-drop (Kwon et al., 2006) and questions like the *millionaire* example are realized with non-overt second person pronouns *pro*. In order to extend our analysis to these we'd have to spell out a semantic treatment of *pro* in Korean, which is beyond the range of the present study. We therefore confine ourselves to the observation that reference to the audience is possible in theme-setting questions; our account is tailored to account for this constellation.

Informants report that the trueQ particle *ni* is not used in theme-setting questions. We assume that this is due to Maximize Presupposition, which forces the speaker to use the more contentful form *na* if possible. The full range of use of trueQ *ni* is still open and we are thus unable to say whether *ni* by necessity expresses a request to some addressee. If this is the case, it offers a further reason why *ni* is inappropriate in theme-setting questions.

5.3. Real self-talk

Finally, we found that speakers cannot address *themselves* with *ne* 'you' in Korean SAQ questions. When speaker A is talking to herself using a second person pronoun, as in (19), the question is only acceptable as a true question (*ni*). Imagine that A, alone and in search of her key, wants to ask herself a question like English "*Now, where is your key…*".

(19)
a. Ney yelsay-ka eti(-ye) iss- ni?
Your key-NOM where(-LOC) exist -trueQ
'Where is your key?'
b. *Ney yelsay-ka eti(-ye) iss- -na?
Your key-NOM where(-LOC) exist -SAQ

While the true question (19a) can be used under these circumstances, the SAQ (19b) is not an option. Our analysis makes correct predictions for (19b), as shown in (20).

(20) [[*na*]]^c requires that *sp*(*c*) = *ad*(*c*).
There are no further bystanders. Hence *by*(*c*) = Ø.
[[*ne-*]]^c must refer to the most salient bystander (= (13))
Hence *ne* cannot refer. The utterance is ill-formed.

It is less clear why (19a) is an acceptable way of self-talk. We see at least two possible explanations. One explanation—less attractive to our mind—could stipulate that trueQ *ni* in (19a) also allows contexts where $sp(c)$=$ad(c)$. This assumption, in turn, requires a special semantics for *ne* in (19a) to allow for $[[\ ne\ ]]^c = sp(c)$. We do not see how this special treatment of *ne* fits the overall picture and how it can be restricted to "self-talk in true questions" in a nonstipulative manner. It also violates (21), to our mind a reasonable universal requirement on second person pronouns.

(21) Second person pronouns *pro* require $[[\ pro\ ]]^c \neq sp(c)$

While we did not explicitly adopt (21) as a presupposition of *ne* ('you') it effectively follows from our analysis. It seems desirable to maintain this prediction.
Avoiding these complications, an alternative explanation of (19a) could rest on play-acting in self-addressed talk. We see (19a) as evidence in favour of the idea that self-talk can address the speaker's *alter ego* (Socka, 2004), an imaginary second interlocutor A' distinct from A. This assumption allows us to integrate (19a) into the present proposal as follows.

(22) a. $[[\ ni\ ]]^c$ = allows for $sp(c) \neq ad(c)$
speaker A appears in *c* as two different entities: A-as-speaker ≠ A-as-addressee.
A-as-addressee is an imaginary interlocutor
A-as-addressee $\in by(c)$ is the most salient bystander
b. $[[\ ney\ ]]^c$ = A-as-addressee

Obviously this preliminary proposal comes with its own stipulations and we do not aim to settle the case as part of the present paper. Yet, Korean allows us to probe the ontology and pragmatics of self-addressing in more detail than the traditional range of European languages and offers an excellent testing ground for future studies on self-talk and soliloquy.

6. Alternative accounts

Our Neo-Kaplanian analysis builds on Jang and Kim's work and extends their proposal in a conservative fashion. The present section reviews alternative analyses of SAQ in other languages and argues that they do not offer a better basis for our data.

6.1. Speas and Tenny (2003), Oguro (2017)

Speas and Tenny claim that root clauses contain a level of speech act phrase (SAP) that includes a SpeakerP, a HearerP and potentially other phrases that serve to represent perspectival and epistemic centers in syntax. While their original proposal is programmatic rather than designed for particular data it was adopted to analyse honorific marking in Japanese (Myiagawa, 2012) and extended to self-addressed questions in Japanese in Oguro (2017). While Oguro's restrictions on the syntax of SAP seems to successfully predict the possible and impossible co-occurrences of honorifics and various question particles in Japanese the putative mapping between SAP and pragmatics remains unclear. We are particularly worried that basic semantic facts of the account, such as the logical type of possible denotata of SpeakerP and HearerP are left open. While the syntactic operations proposed—for instance, binding of pronouns—strongly suggest denotations of type *e*, the paraphrases of pragmatic effects of SpeakerP and HearerP point more in the direction of propositional denotata, that is type $<s,t>$. A further semantically unexplained element in Oguro (2017) is the *point-of-view* head (POV), which is crucial to distinguish SAQ from true questions. According to Oguro the presence of POV is only mandatory in self-addressed questions and, if bound by the SpeakerP, ensures that the question is intended as a SAQ.

Finally, the predictions entailed by Speas and Tenny, and Oguro about the use of questions and SAQ in inappropriate contexts are unclear. Are sentences, uttered in an inappropriate context, syntactically ill formed or does syntax code a different kind of markedness, such as pragmatic incoherence (#), presupposition failure or even simply false utterances? The present analysis has the advantage that pragmatic factors are coded in pragmatics and make predictions about appropriate and inappropriate uses that can be directly tested in a well-understood interface between grammar and meaning.

6.2. Truckenbrodt (2006)

German shows a close correlation between word order and speech act type (Lohnstein, 2007) and it is thus attractive to spell out a link between syntax and pragmatics. Truckenbrodt proposes that C-features in German can capture this correlation. The idea is that features code pragmatic restrictions on utterance context *c,* which, in turn, guide the possible interpretations of sentences. The feature <**epist**> contributes that *sp*(*c*) desires a CG update and <**deont**(**sp**)(**ad**)> contributes that *sp*(*c*) requests *ad*(*c*) to effect a CG update.[8] The **deont** feature can however lack the **ad** argument, in which case no request to the addressee is issued. This, Truckenbrodt argues, codes the pragmatic profile of self-addressed questions and SAQ thus carry the feature <**deont(sp), epist**>.

If we grant that a proper syntax-pragmatics interface can be spelled out and that the truth conditions of **deont** and **epist** can be made sufficiently precise to demarcate the correct contexts, we could propose to code SAQ in Korean as <**deont(sp), epist**> as well. This however covers only part of the pragmatic restrictions imposed by SAQ markers. For one, *na/ka* convey the ignorance/inability condition (see (14)), which would have to be added. Besides, Truckenbrodt's account is not designed to capture the incompatibility between honorific *upni* and SAQ. The features do not code the identity or non-identity of speaker and addressee; likewise the absence of an **ad** feature does not make predictions about the absence/presence of an interlocutor or bystander. The account can thus at best provide a partial basis to explain Korean. The major benefit of syntactic features in the analysis of German—where speech act type and word order correlate—does not play out in Korean where the basic word order remains the same for all speech act types.

6.3. Conversational scoreboard theories

Recent models for question-answer dialogue provide useful tools to investigate discourse. We base our discussion on the table theory (Farkas and Bruce, 2010) but believe that the observations generalize to other models. The table theory codes questions and assertions as moves in a conversational game that allow the interlocutor various moves in reaction. Farkas and Roelofson (2015), Farkas (2018) demonstrate for the SAQ marker *oare* in Romanian how

[8] In declarative sentences *ad*(*c*) is requested to believe the content of the declarative; in questions *ad*(*c*) is requested to answer.

the model can account for questions that do not request an answer from the addressee. Their analysis builds on Farkas and Bruce's (2010) observation that silence in reaction to assertions is usually interpreted as tacit consent (whereby the model refines Stalnaker's 2002 view that assertion effects a common ground update). SAQ, according to Farkas (2018), are questions where remaining silent is simply a normal reaction for the addressee. In other words, SAQ do not request an answer.

The case of Korean poses a challenge for the table model, which endorses a realistic notion of context. The interlocutors as given by the real-world utterance situation are represented as interlocutors at the table, and in the simplest case there are two individuals that alternatingly adopt the role of speaker and addressee. While intentional elements are proposed in some applications (e.g., "attributive" commitments in Malamud and Stevenson, 2015; Poschmann, 2008) the model assumes an overall fixed range of interlocutors. The model thus offers no natural starting point to code the difference between a person figuring as addressee or bystander, and it therefore will also have problems in accounting for the interplay between honorification and SAQ in Korean. If we adopt Farkas' (2018) semantic analysis of *oare* for Korean *na/ka* we can not explain why the speaker may not use honorific *upni* as soon as s/he offers the addressee "silence" as a further permissible reaction to a question. In their present form, table theories cannot downgrade interlocutors to bystanders and cannot code that speakers construe a situation as one of addressing self.

6.4. Truth-conditional accounts of self-addressed questions

Finally, we want to relate our model to approaches that seek to derive the pragmatics of SAQ from the semantic denotation of the questions posed. These accounts assume that questions with additional elements (here: evidential markers) are somehow too demanding and the speaker cannot rationally expect that the addressee will provide an answer. As an escape interpretation, authors argue, the addressee is permitted to remain silent (going with Farkas, 2018) and/or invited to join speculative discourse with the speaker. Several studies in different languages observe that SAQ are used as conversation starters or topic setters rather than just serving as statement of ignorance.

The idea is spelled out in Littell et al. (2010)'s analysis of Salish questions with inferential evidential markers that, according to the authors, are interpreted as *conjectural questions*. A similar road is taken in Eckardt and Beltrama (2019) who investigate German SAQ in verb-end syntax and marked with evidential *wohl*. Adding *wohl* and the effect of verb-end syntax to question Q, they derive a denotation that can be paraphrased as: 'Which of the answers to Q can be inferred if we two pool our relevant knowledge?'. Again, addressee B cannot (usually) straightforwardly answer this question and instead has to remain silent or enter joint speculative discourse.

Like the table models in 5.3, such accounts are not prepared to cover the different roles of a second person B in dialogue, and hence make wrong (or no) predictions about the use of honorifics. Both Littell et al. and Eckardt/Beltrama view the addressee of an SAQ as a full-fledged participant in context and do not propose that $sp(c)=ad(c)$. It will hence be difficult to explain why a full-fledged addressee can no longer be addressed with honorific *upni* if he figures in a SAQ. The link between honorification and SAQ in Korean needs a more differentiated notion of interlocutors, as provided by our Neo-Kaplanian analysis.

7. Summary

We investigated Korean questions marked as self-addressed questions with *na/ka*. We started from data in Jang and Kim (1998), Jang (1999) who suggest that SAQ questions are asked in a context *c* where speaker and addressee are identical. While the assumption can also explain why honorific *upni* is prohibited in SAQ, it is challenged by observations about second person *ne* 'you'. Second person pronouns can be used to refer to other persons even in SAQ. These persons must however be unable to answer the question and the speaker does not request an answer. We derived these pragmatic requirements on basis of systematically elicited examples. Our analysis rests on (a) bystanders as an additional parameter of Korean utterance contexts and (b) a generalized analysis of second person pronouns as 'the most salient bystander'. We propose the following pragmatic requirements of *na/ka*: The speaker and addressee in *c* are identical, and *if* there are bystanders in *c*, the speaker does not request them to answer and does not believe that they can answer the question. The latter requirement captures the fact that Korean speakers cannot use SAQ if they simply want to release the second person from giving an answer (the *Quiz Game* example).

The analysis can successfully account for the full range of SAQ examples: the *Key, Genius* (first person), *Genius* (second person), *Genius* (second person, past), *Fleurop* and *Photo talk.* It extends to theme-setting questions in Korean. Finally, it correctly predicts that the speaker cannot address to herself with *ne* 'you' in SAQ in Korean. The language thus differs from SAQ questions in other, notably Europan languages, and offers a new way to probe soliloquy and imaginary *alter ego*. To round out the picture it will be interesting to test further types of non-canonical question, such as rhetorical questions and exam questions, as well as the interaction of questions with other pragmatic markers like evidential *-te* (Lim, 2011). We leave these for future study.

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Ineffability and Unexhaustification[1]

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Abstract. Maximize Presupposition seems to apply globally in some cases, but locally in others. Singh's (2011) account resolves this tension, but makes crucial use of dynamic semantics. We observe that an alternative static account is possible based on the principle AVOID INEFFABILITY!. The principle licenses non-local application of maximize presupposition if and only if the structure is otherwise ineffable. After presenting our analysis, we move on to discuss cases where our account and Singh's make different predictions. Focusing on inferences associated with *wh*-questions in Spanish, we argue that our static account makes the correct predictions, while Singh's dynamic account does not.

Keywords: presupposition, implicature, dynamic semantics, Spanish, projection.

1. Introduction

In this paper, we aim to provide an analysis of Maximize Presupposition! (MP) inferences (Heim 1991), that resolves the tension between the need for global and local application. We couch our analysis in terms of a grammatical operator **exh**, which we take to be responsible for MP inferences, following Magri (2009) and Marty (2017). We go on to propose a novel principle governing the distribution of **exh**: AVOID INEFFABILITY!, which, we argue, successfully accounts for the distribution of global vs. local MP inferences. In the final part of the paper, we compare our account to an existing account of local vs. global MP inferences – namely, Singh's (2011) dynamic account of *Maximize Presupposition!*. Building on data from Spanish *wh*-questions from (Maldonado, 2017), we argue that AVOID INEFFABILITY! makes superior predictions to Singh's dynamic account in cases involving more than two presuppositional alternatives.

In this paper, we point out some issues with Heim's (1991) principle of MP, when conceived of as a reflex of grammatical exhaustification (Magri 2009, Marty 2017). In the first part of the paper, we point out that the grammatical theory does not obviously capture the epistemic status of MP inferences. We propose a fix with two components: (i) Meyer's (2013) Matrix K operator, and (ii)) a novel principle governing licit Logical Forms – AVOID INEFFABILITY!. In the second part of the paper, we present independent evidence for AVOID INEFFABILITY! from constituent questions in Spanish.

2. Background

2.1. Global *Maximize Presupposition!*

We begin by considering the original formulation of MP of Heim's, in (1).[2]

(1) MAXIMIZE PRESUPPOSITION!
Make your contribution presuppose as much as possible!

[1]We'd like to especially thank Andreea Nicolae and Paul Marty for useful comments as feedback, as well as audiences at SuB 23 and ZAS. We're grateful for financial support from grant DFG SA 925/11-2 LISI.

[2]It is important to keep in mind that maximize presupposition is furthermore restricted to constrained sets of alternatives.

Originally introduced by Heim (1991) in the discussion of definiteness, work by Sauerland (2002, 2003, 2005, 2008a) showed that the principle can account for data in a number of other domains (tense, number and other ϕ-features, focus, and quantifiers). Let's briefly illustrate how MP accounts for the oddness of certain sentences. Consider the examples below (adapted from Singh 2011). In each case, the (b) example if presuppositionally stronger than the (a) example. Furthermore, the presupposition of the (b) example is entailed by the common ground. The principle in (1) therefore correctly predicts that, in each case, the (a) example is unusable – via Gricean reasoning, the (a) examples imply the speaker does not believe that the presupposition of the (b) example is satisfied, which clashes with the common ground.

(2) a. #A sun is shining

b. The sun is shining.[3]

(3) a. #All of John's eyes are open.

b. Both of John's eyes are open.[4]

(4) a. #John thinks that Paris is in France.

b. John knows that Paris is in France.[5]

(5) a. #The suns are shining.

b. The sun is shining.[6]

In this paper, we are concerned with the interaction between quantification and the application of MP. In early work on MP, MP was assumed to apply globally at the level of the speech act and therefore take scope over every quantifier in a sentence. Since global application predicts differences between inherent and implicated presuppositions, this pattern of interaction between quantifiers and MP was used as a diagnostic for the latter. Consider for example the pair of examples in (6) from Sauerland (2002): Sauerland claimed that the inherent presupposition of the past tense applies to every Tuesday interval of this month and therefore (6b) could also be used at utterance times that are in the past of all Tuesdays of this months. The present tense, however, would only carry an implicated presupposition that the evaluation time contain the speech time. Consequently, the analysis predicts that (6a) could be used at any time up to and including the last Tuesday of this month.[7]

[3]Presupposes uniqueness.
[4]Presupposes duality.
[5]Presupposes truth of the embedded proposition.
[6]Presupposes uniqueness.
[7]See Thomas (2014) for a detailed critique of Sauerland's argument.

(6) a. Every Tuesday this month, I fast.

b. Every Tuesday this month, I fasted.

The argument assumes that tenses are temporal variables that can carry a presupposition following Heim (1994), and are alternatives for the purposes of MP. Outside the scope of quantifier the presuppositions of past and present are therefore predicted to be mutually exclusive regardless of whether past is lexically specified as before-the-utterance-time and present vacuous or whether past is vacuous and present is lexically specified as non-before-the-utterance-time. But in the scope of a quantifier the predictions of these two analyses diverge if (and only if) MP applies globally. Global application of MP predicts that if the range of the quantifier contains some past and some present intervals, the vacuous tense should be used. This assumption and the observation that (6a) can be used when some Tuesdays are already past lead Sauerland to conclude that the present tense must be vacuous. The divergent behavior of implicated presuppositions that global MP predicts is observed also with number and other ϕ-features (Sauerland, 2003, 2008b) and with definiteness (Sauerland, 2003).

The epistemic status of implicated presuppositions can be viewed as a further case of global MP, in light of Meyer's (2013; 2014) grammatical analysis of ignorance. Heim (1991) observes that the inference derived from MP has a weak epistemic status in example (7). Specifically, Heim points out that the definite (8) allows us to infer that the speaker is *certain* that there is a unique 20 ft. catfish – this is what we expect based on its status as a presupposition. (7) is different: we can only infer: it's not the case that the speaker is certain that there is a unique 20 ft. catfish. It is compatible with (a) the speaker being certain that there is more than one 20 ft. catfish, or (b) the speaker is not certain whether or not there is more than one.

(7) Robert caught a 20 ft. catfish.

(8) Robert caught the 20 ft. catfish.

Heim's (1991) global account predicts that speakers should use the marked form, namely the definite (8), whenever they are certain that its presupposition is satisfied, but speakers should use the unmarked form, the indefinite (7), either if they are uncertain whether the presupposition of the marked form is satisfied, or if they are certain that the presupposition of the marked form is *not* satisfied.[8] Heim's observation reduces to global application of MP, once one adopts Meyer's (2013; 2014) *Matrix K axiom*.

(9) **Matrix K Axiom** (Meyer, 2014: p. 583)
Assertion of ϕ is parsed as $K_s\phi$ at LF.

The Matrix K Axiom states that all assertively uttered sentences are covertly modalized by an operator K_s anchored to the beliefs of the speaker s. K is taken to universally quantify over

[8] In later work, Heim's observation is related to the epistemic step with scalar implicatures Sauerland (2004) introduced, e.g., Chemla (2008).

the speaker's doxastic alternatives, much like the attitude verb *believe*. The LF we assume for Heim's (1991) example, used to motivate the epistemic status of implicated presuppositions, is given below. Note that we assume here that MP is a reflex of a covert operator **exh**, following Magri (2009) and Marty (2017).

(10) **exh** K_s [Robert caught a 20 ft. catfish]

Due to independently known facts concerning how presuppositions project through attitudes (Heim 1992),[9] the alternative to the sentence above, namely K_s *[Robert caught the 20 ft. catfish]* is predicted to presuppose that the speaker believes that there is a unique 20 ft. catfish. Applying MP within the scope of Meyer's K_s operator therefore predicts that the strengthened presupposition of the sentence should be the negation of the aforementioned presupposition. The sentence as a whole is correctly predicted to presuppose that it's not the case that the speaker believes that there is a unique 20 ft. catfish. A stronger presuppositional implicature – namely, that the speaker believes there is not a unique 20 ft. catfish, is derived if **exh** is inserted below K_s. In this way, purely global application of MP makes a number of correct predictions. But we discuss problems for global MP in the next section.

2.2. Local *Maximize Presupposition!*

Percus (2006) observed that examples like (11) pose a problem for a formulation of MP as a global maxim, applying at the level of the speech act.

(11) a. Everyone with exactly two students
assigned the same exercise to both of his students.

b. #Everyone with exactly two students
assigned the same exercise to all his students.

If we apply the principle MP to (11a), the predicted presupposition (via universal projection) is: *everyone with exactly two students has exactly two students*. (11a) therefore presupposes a tautology, and is not globally presuppositional. For this reason, (11a) and (11b) should not compete for the purposes of MP. But, intuitively, we want to conjecture that it is the presence of the presuppositionally weaker competitor *all* in (11a) which is responsible for the unusability of the sentence. It seems undesirable to posit a new principle to explain cases like (11).

The contrast between global and local application of MP is also observed with indefinites and plurals. Consider the following examples: (12a) requires local MP as in Percus's example, but (12b) seems false since the Earth and its single moon falsify the assertion and hence requires global MP.

[9] We assume here that presuppositions project through K_s in the same way as they project through attitude verbs such as *believe* – that is to say, the sentence *x believes* ϕ presupposes that *x* believes the presuppositions of ϕ.

(12) a. If a planet has a single moon, {the moon of it is|#the moons of it are|#a moon of it is} almost ice free.

b. {A moon of every planet is|Every planet's moons are} totally covered in ice.

Singh (2011) was the first to propose that MP applies *locally*, to subsentential constituents.[10] For the following discussion, we adopt Magri's (2009) formalization of local MP as a reflex of the grammatical exhaustivity operator **exh**. Magri's approach to presupposition is couched in terms of the bidimensional theory of Karttunen and Peters (1979).[11] A sentence ϕ denotes a pair, consisting of its presupposition ϕ_{prs} and its assertion ϕ_{asr}.

(13) $[\![\phi]\!] = \langle \phi_{prs}, \phi_{asr} \rangle$

The presuppositional formulation of **exh** is given in (14). It takes a sentential prejacent ϕ, and returns a pair consisting of ϕ's *strengthened* presupposition, and ϕ's *strengthened* assertion.

(14) $[\![[\mathbf{exh}_{\text{MP}}\ \phi]]\!] = \langle \text{EXH}_{prs}(\phi_{prs}), \text{EXH}_{asr}(\phi_{asr}) \rangle$

Since we'll be focusing exclusively on the presuppositional dimension, we only provide the algorithm here for deriving the strengthened presupposition.

(15) **Strengthened Presupposition**

a. $\text{EXCL}_{prs}(\phi) = \left\{ \psi \in \text{ALT}(\phi) : \phi_{prs} \to \psi_{prs} \right\}$

b. $\text{EXH}_{prs}(\phi) = \phi_{prs} \wedge \forall \psi [\psi \in \text{EXCL}_{prs}(\phi) \to \neg \psi_{prs}]$

(15) says, essentially, that the strengthened presupposition of ϕ is derived by negating every alternative to ψ, such that the presupposition of ψ is logically non-weaker than the presupposition of ϕ.[12] Let's see how presuppositional **exh** accounts for Percus's problematic example:

(16) [② [Everyone with exactly two students]
λx ① **exh** [x assigned the same exercise to all his students]]

[10] We do not adopt the specifics of Singh's proposal here as it does not seem sufficiently general for our purposes. But Singh's use of Stalnakerian local contexts is relevant later.

[11] There are some well-known problems with approaches such as this which divorce the assertive and presuppositional components of meaning completely. See Marty (2017) for a complete reformulation of Magri's presuppositional **exh** in terms of a partial semantics for presupposition. As far as we can see, the bidimensional formulation of **exh** suffices for our purposes, so we adopt it for its expository simplicity.

[12] This definition elides several important implementational details, such as the algorithm for computing alternative. We address these points as they come up.

(17) a. $[\![x \text{ assigned the same exercise to all his students}]\!]$ [13]

$$= \left\langle \begin{array}{l} \emptyset, \\ x \text{ assigned the same exercise to all his students} \end{array} \right\rangle$$

b. $[\![x \text{ assigned the same exercise to both his students}]\!]$ [14]

$$= \left\langle \begin{array}{l} x \text{ has exactly two students}, \\ x \text{ assigned the same exercise to all his students} \end{array} \right\rangle$$

(18) $$[\![①]\!] = \left\langle \begin{array}{l} x \text{ does not have exactly two students} \\ x \text{ assigned the same exercise to all his students} \end{array} \right\rangle$$ [15]

(19) $[\![②]\!]$ [16]

$$= \left\langle \begin{array}{l} \text{everyone with ex. 2 students does not have ex. 2 students} \\ \text{everyone with ex. 2 students assigned the same exercise to all}\ldots \end{array} \right\rangle$$

Treating MP as the reflex of **exh** has a number of advantages over other accounts of MP inferences. Aside from straightforwardly accounting for local MP inferences, it accounts for a number of parallels between scalar implicatures and MP inferences: (i) Both scalar implicatures of MP inferences involve strengthening relative to logically non-weaker alternatives; for implicatures, the alternatives are assertive, for MP inferences, they are presuppositional. (ii) MP inferences seem to be both obligatory, and blind to the common ground (see the examples at the beginning of the paper). Magri has argued that scalar implicatures exhibit this behaviour too; (20) gives rise to an obligatory scalar implicature, despite the fact that the implicature clashes with the common ground.

(20) #Some Italians are from the same country.[17]

We observe a similar effect with MP inferences:

(21) #Rome is a capital city of Italy.[18]

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[13]The prejacent of **exh** is non presuppositional.
[14]The alternative presupposes duality.
[15]Since the presupposition of the alternative is (vacuously) logically non-weaker than that of the prejacent, **exh** returns its negation as the strengthened presupposition of its prejacent.
[16]In line with standard assumptions about presupposition projection, the strengthened presupposition of the prejacent projects universally through the universal statement. The predicted global presupposition is a contradiction!
[17]Implicates: *Not all Italians are from the same country.*
[18]Implicates: *There is no unique capital city of Italy.*

On the basis of these parallels, following Marty (2017) we refer to MP inferences as *presuppositional implicatures* in the following.

2.3. Aligning Global and Local: AVOID INEFFABILITY!

But hey, wait a minute – in order to account for Percus's data, **exh** should apply obligatorily, in a blind fashion, to every possible subsentential node. There should only be one possible LF for Heim's example, namely (22). We need a principle which blocks (22) in a context where the speaker is not sure that the presuppositions of the alternative are *not* satisfied.

(22) **exh** K_s **exh** [Robert caught a 20 ft. catfish]

Singh (2011) makes a proposal that is applicable to this and the other cases of global MP we discussed above. Specifically, Singh introduces an antipresuppositional admittance condition within a theory of presupposition based on local contexts. Singh crucially doesn't make use of a grammatical operator to generate implicated presuppositions, but instead employs two conditions: *Local* MP and *Context Admittance*.

(23) a. *Local* MP
Check that MP is satisfied for each S embedded in ϕ in Ss local context c'.

b. *Context Admittance*
A context c admits a sentence S just in case each of the constituent sentences of S is admitted by the corresponding local context.

Consider Singh's (p. 163) discussion of a relevant example. Singh points out that $+x_i$ *submitted all his papers* is blocked by Local MP when the condition of $+x_i$ *submitted both his papers* is met.

(24) a. Every x_i; x_i a candidate, x_i submitted all of his papers.

b. Every x_i; x_i a candidate, x_i submitted both of his papers.

Because the dynamic condition takes the sentential context into account, it also predicts Percus's cases of local MP: In the following example, $+x_i$ *submitted all his papers* is evaluated at a point when all local contexts contains on assignments that map x_i to a candidate that has written exactly two papers. Hence MP is violated.

(25) Every x_i; x_i a candidate, x_i has exactly two papers, x_i submitted all of his papers.

Singh's conditions successfully accounts for the contrast between the cases of apparent global and local application of MP by extending the dynamic account of presupposition satisfaction. Singh's account must take into account all available contexts when MP is computed locally. In this, it goes beyond the power required by Heim's account of presupposition projection which is fully intersective, in the sense of Rothschild and Yalcin (2017). Our contribution is to show that instead of Singh's non-intersective account, an intersective account of MP is possible and, as we show in the final section, makes a better empirical prediction at least in one case.

We propose the following constraint AVOID INEFFABILITY!, which allows **exh** to be *deactivated*, just in case application of **exh** predicts a presupposition failure for a sentence and *all of its alternatives*.

(26) AVOID INEFFABILITY!: Deactivation of n occurrences of $\mathbf{exh}_{\mathbf{MP}}$ to $\cancel{\mathbf{exh}_{\mathbf{MP}}}$ in an LF ϕ is licit in a context C iff:

a. there is no other LF ψ in ALT(ϕ), such that ϕ and ψ are Strawson-equivalent

b. C satisfies the presuppositions of ψ

c. ψ contains at most $n-1$ occurences of $\cancel{\mathbf{exh}_{\mathbf{MP}}}$.

The intuition we wish to cash out is as follows: imagine we're in a scenario where the speaker is uncertain whether there exists a unique catfish; maybe there does, maybe there doesn't. In such a scenario, neither (27), nor its alternative (28) is usable. In such a case, the constraint in (26) allows *deactivation* of the embedded occurrence of **exh** in (27), resulting in (29).

(27) **exh** K_s **exh** [Robert caught a 20 ft. catfish]

(28) **exh** K_s **exh** [Robert caught the 20 ft. catfish]

(29) **exh** K_s ~~**exh**~~ [Robert caught a 20 ft. catfish]

Our proposal, in a nutshell is that, in order to reconcile the grammatical approach to presuppositional implicatures with their epistemic status, we need to posit an apparently ad-hoc constraint which allows **exh** to be deactivated under certain circumstances. Like Singh's, our account introduced an additional condition to account for the global MP data. We argue in the next section that further evidence from *wh*-questions in Spanish follows from our Avoid Ineffability condition, but seems problematic for Singh's proposal.

3. The presuppositions of *wh*-questions

In the case above, we were dealing with just two alternatives, ordered by presuppositional strength. Once we start dealing with more than two alternatives ordered by presuppositional strength, AVOID INEFFABILITY! makes different predictions from Singh's proposal. Our case: Interrogative pronouns in Spanish (building on Maldonado 2017, and joint work with Andreea Nicolae – Elliott et al. 2018).

The abstract structure of the case as follows: there are three alternative forms, one of which, A_{12} has two presuppositions p_1 and p_2, the other one, A_1, has only presupposition p_1, and the third one, A_0, has no relevant presupposition at all. Then A_1 when locally exhaustified as (30a) has the presupposed implicature that $\forall x\ \neg p_2(x)$. Assume now that actually $\forall x\ \neg p_2(x)$ is false and $\forall x\ \neg p_1(x)$ is true. Then Singh's proposal predicts that the use of A_2 should be licit. AVOID INEFFABILITY!, however, is not satisfied in this scenario because A_0 as in (30a) is available.

(30) a. $\mathbf{exh}\ \forall x\ .\ \mathbf{exh}\ A_1(x)\ \_\ \mathbf{exh}\ \forall x\ \cancel{\mathbf{exh}}\ A_1(x)\ \_\ \mathbf{exh}\ \forall x\ .\ \mathbf{exh}\ A_0(x)$

Consider briefly the possible example of English gender marking in dialects that reject the use of the masculine form as a default (i.e. where *every student enjoyed themself* is used rather than *every student enjoyed himself.*). Could this be a case with the abstract structure we are looking for. The feminine form carries the presuppositions of singular and feminine, the masculine form only singular, and the plural form carries no relevant presupposition (Sauerland, 2008b). The use of *him* with a mixed-gender group requires structure (30a), but structure (30a) avoids ineffability too, and therefore (30a) can be blocked. However, this example is further complicated by the fact that (30a) should also trigger an presuppositional implicature of number. This may be behind the different dialectal preferences, but leads us to put the example aside for the time being and focus on Spanish *wh*-expressions.

3.1. Background assumptions

In Spanish, singular simplex *wh*-expressions do not carry a uniqueness presupposition, whereas plural simplex *wh*-expressions nonetheless carry an anti-singleton inference. Anti-singleton inferences are derived as presuppositional implicatures, via competition with a competitor with a uniqueness presupposition.

(31) Qué chico se fue pronto?
Which boy.SG REFL left early?

a. John left early.

b. #John and Bill left early.[19]

(32) Qué chicos se fueron pronto?
Which boy.PL REFL left early?

a. #John left early.

b. John and Bill left early.[20]

(33) Quién se fue pronto?
Who.SG REFL left early?

a. John left early.

[19]Spanish singular *which*-Q: ✓UP
[20]Spanish plural *which*-Q: ✓ASI

b. John and Bill left early.[21]

(34) Quiénes se fueron pronto?
Who.PL REFL left early?

a. #John left early.

b. John and Bill left early.[22]

Furthermore, we assume that interrogatives obligatorily compose with Dayal's (1996) answerhood operator.

(35) $\text{ANS}_w(Q) = \iota p \in Q[p(w) \wedge \forall p' \in Q[p'(w) \rightarrow p \subseteq p']]$

We use this data to motivate two entries for the singular simplex *wh*-expression: a presuppositionally weaker entry, ranging over quantifiers, and a phantom, presuppositionally stronger entry, ranging over atoms. The phantom entry is only detectable by virtue of the MP inference. We therefore have a three-way competition between simplex *wh*-expressions in Spanish:

- *quien*$_{\langle et,t\rangle}$.SG: does not presuppose existence of any individual (hence any answer)
- *quienes*$_{\mathsf{e}}$.PL: presupposes existence of an individual (hence an answer)
- *quien*$_{\mathsf{e}}$.SG: presupposes the unique existence of an individual (hence the existence of a unique answer involving an individual)

3.2. Analysis

Maldonado (2017) observes that simplex *wh*-expressions have the following distribution in an uncertainty scenario (data from Maldonado). The acceptability of each example is judged relative to a context in which Juan is expecting at least one friend to come to the party, but two or more might also come

(36) *Juan no sabe* { *quien*$_{\langle et,t\rangle}$.SG | *#quien*$_{\mathsf{e}}$.SG | *#quienes*$_{\mathsf{e}}$.PL } *van a venir a*
Juan not know who.SG who.SG who.PL go PREP come to
la fiesta
the party

'Juan doesn't know who will come to the party'

[21] Spanish singular simplex *wh*-Q: ✗UP
[22] Spanish plural simplex *wh*-Q: ✓ASI

(37) *Juan no sabe* { *#qué amigo* | *qué amigos* } *van a venir a la fiesta*
Juan not know which friend.SG which friend.PL go PREP come to the party

Observe that which.PL is usable in an uncertainty scenario, whereas who.PL is not. This is because which.SG presupposes uniqueness – since (strengthened) which.PL and all of its alternatives are unusable, deactivation of **exh** is licensed in this context via AVOID INEFFABILITY!.

(38) Juan does not know ~~**exh**~~ which friend.PL will come to the party.

However, who.PL *does* have a usable alternative – namely, $quien_{\langle et,t\rangle}$.SG. This means that **exh** may not be deactivated, since the conditions of AVOID INEFFABILITY! are not met, correctly predicting that who.PL should be unusable in this context.

(39) #Juan does not know {**exh**|*~~**exh**~~} who.PL will come to the party.

Here is a more detailed derivation of the anti-singleton inference for who.PL:

(40) ③ Juan not know ② EXH [① ANS who.PL will come to the party]

(41) $[\![①]\!] = \left\langle \begin{array}{l} \text{one or more people will come to the party,} \\ \text{ANS(who.PL will come to the party)} \end{array} \right\rangle$

(42) ①′ ANS who_e.SG will come to the party $\in$ ALT(①)

(43) $[\![①']\!] = \left\langle \begin{array}{l} \text{exactly one person will come to the party,} \\ \text{ANS(who}_e\text{.SG will come to the party)} \end{array} \right\rangle$

(44) $[\![②]\!] = \left\langle \begin{array}{l} \text{more than one person will come to the party,} \\ \text{ANS(who.PL will come to the party)} \end{array} \right\rangle$

(45) $[\![③]\!] = \left\langle \begin{array}{l} \text{Juan believes that more than one person will come to the party,} \\ \text{Juan doesn't know who will come to the party} \end{array} \right\rangle$

In sum, we propose that in Spanish *wh*-questions three simple *wh*-expression can stand in competition as in the following table.

expression	type	presuppositions	alternative
quien[1] (GQ)	$\langle\langle\langle\langle e,t\rangle,t\rangle,t\rangle,t\rangle$	—	—
quienes	$\langle\langle e,t\rangle,t\rangle$	existence	*quien*
quien[2]	$\langle\langle e,t\rangle,t\rangle$	existence, uniqueness	—

These three expressions allow us to test the difference between Singh's dynamic analysis of apparently non-local application of MP and our account. The data Maldonado reports support our proposal: In a scenario where the existence presupposition of *quienes* is satisfied, but the presuppositional implicature of plurality isn't locally satisfied, *quien* is preferred of *quienes*.

4. Conclusion

In this paper, we've aimed to resolve a tension between (a) apparently obligatory local application of MP, to account for data originally pointed out by Percus (2006), and (b) cases where MP must apply globally, in order to account for Heim's (1991) observations concerning the weak epistemic status of MP inferences. In order to do so, we adopted a conception of MP as the reflex of a grammatical exhaustification operator, following Magri (2009) and Marty (2017). We went on to propose a novel principle governing the distribution of this operator: AVOID INEFFABILITY!, which we show successfully mediates between cases of global vs. local MP inferences. In the final part of the paper, we argued explicitly that our principle is empirically superior to, e.g., Singh's (2011) dynamic account, based on evidence from *wh*-questions in Spanish.

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A measure based analysis of plural mass nouns in Greek[1]

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Abstract. This paper explores the feasibility of accounting for plural mass nouns in Greek via a measure function that is assumed to be part of the meaning of plural nouns. Such an approach is used to account for the readings of plural count nouns in Krifka (1989, 1995) and Grimm (2013). The characteristics of plural mass nouns in Greek, however, present a particular challenge that cannot be straightforwardly applied to previous measure based analyses. Greek plural mass nouns are used to discuss amounts of a substance, sometimes small and sometimes large, and are accompanied by a particular inference that disappears in certain contexts. These characteristics have been analyzed in a variety of ways (Tsoulas, 2009; Alexiadou, 2011; Chierchia, 2015; Kane et al., 2015; Kouneli, 2019) though never in terms of measurement. I argue that a measure based analysis that incorporates a structure of discourse based on questions under discussion (Grimm, 2013; Roberts, 1996) can account for the characteristics of plural mass nouns in Greek. I build this analysis on the rich, context sensitive lexical structures in Sutton and Filip (2017), as they can straightforwardly accommodate a notion of context-sensitive measurement that can apply to both count and mass nouns in Greek.

Keywords: plurality, count/mass, Greek, measurement, context-sensitivity.

1. Introduction

The point of departure for this paper is the assumption that mass nouns in number marking languages, e.g. English, do not straightforwardly take number morphology (Pelletier, 1975; Allan, 1980; Chierchia, 1998, 2010, 2015) unless shifted to portion or kind readings. This assumption is supported by the fact that (1) is deemed ungrammatical while (2) is not.

(1) *There are bloods on the wall. (Chierchia, 1998: p. 55)

(2) In this lab we store three bloods. ⇒
In this lab we store three kinds of blood. (Chierchia, 1998: p. 57)

The inability to straightforwardly pluralize mass nouns is sometimes predicted on related assumptions, for example Chierchia (1998) assumes that mass nouns are semantically plural, so they cannot take plural morphology.

In contrast to this assumption is the fact that some number marking languages allow mass nouns to take plural morphology without being shifted to a kind or portion interpretation. This phenomenon has been documented in Greek (Tsoulas, 2009), Persian (Sharifian and Lotfi, 2003), Hebrew (Doron and Müller, 2013), Halkomelem Salish (Wiltschko, 2008), Ojibwe (Mathieu, 2012; Wiltschko, 2012), and Blackfoot (Wiltschko, 2012).

(3) Trehoun nera apo to tavani.
drip.3RD.PL water.PL.NEUT.NOM from the ceiling.NEUT.SG
'Water is dripping from the ceiling' (Tsoulas 2008 p. 133)

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The un-shifted plural mass nouns in Greek, (3), have been associated with a particular inference that has been described as a 'much' inference by Tsoulas (2009) and Alexiadou (2011), an abundance inference by Kane et al. (2015), and more recently as a 'spread/scattered' inference by Kouneli (2019) given the amounts described can be very small, and they are often spread or scattered across a surface. This inference has also been shown to disappear in certain cases by Kane et al. (2015). These have led to typological claims about number marking and several different analyses of formally marked plurals. Tsoulas (2009), for example, argues that plural morphology is sum-creating for count nouns but redundant plurals on mass nouns, Acquaviva (2008); Alexiadou (2011) and Kouneli (2019) distinguish between grammatical plurals (plural count nouns) and lexical plurals (the sort seen in (3)), and Chierchia (2015) defines distinct systems of number marking where that in English is strong and that in Greek is weak.

This paper discusses the feasibility of accounting for these mass nouns via a measure function that is assumed to be part of the meaning of plural nouns. Such an approach is used in Krifka (1989, 1995) and Grimm (2013) to account for the readings of plural count nouns. Combined with the QUD-based approach to the analysis of the readings of plural nouns argued for by Grimm (2013), this paper shows that a measure based analysis of plurals allows a more uniform treatment of Greek plural nouns than has been previously proposed and it also accounts for the 'spread/scattered' interpretation argued for by Kouneli (2019).

2. Background: Greek Data

While Greek has a straightforward mass/count distinction similar to that in other number marking languages—e.g. English—Greek is unlike most other number marking languages in that it has plural mass nouns that are true mass nouns (Tsoulas, 2009). The mass/count distinction in Greek can be uncovered using the sort of tests outlined by Chierchia (1998), such as the ability of nouns to directly combine numericals. As is typical in number marking languages, object denoting nouns like *molyvi* ('pencil') can directly combine with numericals like *dio* ('two') and are therefore reveled to be count, while substance denoting nouns like *melani* ('ink') cannot straightforwardly combine with a numerical—i.e. they cannot combine with a numerical outside of a context that enforces a kind or portion interpretation—and are therefore revealed to be mass.

(4) a. dio molyvia
two pencil.PL
'two pencils'

b. dio melania
two ink.PL
#'two inks'

At the same time, plural morphology is straightforwardly infelicitous on mass nouns in English (Chierchia, 1998), but plural morphology is acceptable on mass nouns in Greek as in (3). The interpretation of a plural mass noun like *nera* ('waters') in (3) has been described as one in which there is an abundance of water (Tsoulas, 2009; Alexiadou, 2011; Kane et al., 2015), though it has recently been argued that 'spread/scattered' better captures the notion (Kouneli, 2019). Crucially, examples like (3) do not involve a shift to portions or kinds, which is shown in the fact that these plural mass nouns cannot be counted as in (5).

(5) *Dio nera trehun apo to tavani.
two water.PL run from the ceiling
'Two waters dripped from the ceiling (Tsoulas, 2009: p. 135)

Because these nouns cannot be counted, they are true mass nouns, and are here referred to as *plural mass nouns*.

It has been claimed that Greek mass nouns can freely pluralize (Kouneli, 2019). At the same time, it has been noted that there are some lexical restrictions on Greek plural mass nouns (Alexiadou, 2011) and contextual restrictions as well Tsoulas (2009).

Alexiadou (2011) claims there are lexical restrictions on Greek plural mass nouns, in respect to how freely certain nouns pluralize and which predicates they occur with. In particular, *nero* (‘water’), *ladi* (‘oil’), *laspi* (‘mud’), *ammos* (‘sand’), *rizi* (‘rice’), *chioni* (‘snow’) seem better in plural form than *meli* (‘honey’), *chymos* (‘juice’), *kykloforia* (‘traffic’) (Alexiadou, 2011: p. 36). At the same time, Greek plural mass nouns are often found with *spray/load* predicates like ‘fall’, ‘spray’, ‘drip’, ‘gather’. These restrictions on plural mass nouns suggest that, though pluralization of mass nouns may be free according to Kouneli (2019), there is nevertheless a relationship between the nouns themselves and the predicates with which they occur.

Additionally, Tsoulas (2009) shows that there are contextual restrictions on Greek plural mass nouns. For example, it would be perfectly felicitous to use *nera* (‘waters’) when there is water covering the kitchen floor (6) or *amous* (‘sands’) when someone has tracked sand into their house (7), but it would be infelicitous for a bricklayer to use *laspes* (‘muds’) to refer to the mortar in a mixer to be used for bricklaying (8).

(6) To patoma itan gemato nera.
the floor was full water.PL
‘The floor was full of water.’ (Tsoulas, 2006: p. 5)

(7) Irthe katefthian apo tin amoudia mesa ke mas gemise amous.
came-he straight from the beach inside and us.CL filled sand.PL
‘He came from the beach straight inside and filled the place with sand.’
(Tsoulas, 2006: p. 5)

(8) *I laspes eginan.
The mud.PL are-done
‘The mortar is ready.’
(when pointed to by a brick-layer who is mixing mortar) (Tsoulas, 2009: p. 134)

The intuition that arises from such examples is that contained or collected substances are less acceptable than spread or scattered substances when it comes to the use of plural mass nouns (Tsoulas, PC).

The intuition that plural mass nouns encode a notion of ‘spread/scattered’ has been argued for by Kouneli (2019). To argue in favor for ‘spread/scattered’ as opposed to ‘much’, Kouneli (2019) provides contexts in which larger volumes—i.e. abundances—of substances correspond to infelicitous uses of plural mass nouns relative to contexts with smaller, but nevertheless spread/scattered amounts of a substances. For example, when a pan is full of rice, cooked for a meal and ready to serve, only the singular is appropriate in a sentence like (9a). If a pan has a handful of grains of rice scattered across its surface after a meal has been eaten, for instance, then it is appropriate to use the singular or plural (9b).

(9) a. I katsarola exi rizi.
the.NOM pan.NOM.SG has.3SG rice.ACC.SG
‘The pan has rice.’

b. I katsarola exi rizia.
the.NOM pan.NOM.SG has.3SG rice.ACC.PL
'The pan has rice all over its surface.' (Kouneli, 2019: p. 241)

Similar to a pan of rice, when someone fills a tub with water in preparation for a bath, the tub full of water can only be described as such with *nera* ('water') in the singular (10a). On the other hand, before the bathtub has been filled, if that person walks into the bathroom expecting to find a dry tub, but instead finds one with a bit of water in the bottom and on the upper edge, it can be described as full of *nera* ('water') or *nero* ('waters') as in (10b).

(10) a. I baniera ine gemati nero.
the.NOM bathtub.NOM.SG is.3SG full.NOM.SG water.ACC.SG
'The bathtub is full of water.'

b. I baniera ine gemati nera.
the.NOM bathtub.NOM.SG is.3SG full.NOM.SG water.ACC.PL
'There is water all over the bathtub's surface.'(Kouneli, 2019: p. 241)

Kouneli (2019) argues that these examples show that the interpretation of the plural mass noun is "spread over a surface in a disorderly way", rather than "a great amount of".

3. Previous Analyses

Kane et al. (2015) lay out two challenges that plural mass nouns in Greek pose:

(A) THE CROSSLINGUISTIC CHALLENGE:
What distinguishes languages, like Greek, which allow pluralized mass nouns, from those like English which do not?

(B) THE INFERENCE CHALLENGE:
How should we account for the inference that pluralized mass nouns give rise to in those languages in which they are allowed? (Kane et al., 2015: p. 318)

These challenges encompass much of what needs to be answered in an analyses of plural mass nouns, namely what is it about Greek that permits the use of plural morphology on mass nouns, and what is the nature of the accompanying inference. In light of the more recent data from Kouneli (2019), I propose that there is one more challenge that must also be met with respect to the use of plural mass nouns in Greek.

(C) THE CONTEXTUAL CHALLENGE:
How should we account for the fact that certain amounts/distributions of substances are necessary for a plural mass noun to be acceptable in a given context?

Each of these challenges have been addressed by previous analyses of plural mass nouns in Greek, though as will be discussed none of these analyses have comprehensively answered the associated questions.

3.1. Tsoulas (2009) and Chierchia (2015)

Tsoulas (2009), argues that Greek number marking is unlike number marking in English, which, according to Chierchia (1998), maps a set of atoms onto the set of sums of those atoms. Rather than being tied to the semantic pluralization operation as is the case with plural morphology in

English, Tsoulas (2009) argues that Greek plural morphology results in a structure more like intersective adjectival modification, where plural morphology contributes a quantity implicature.

(11) Waters = water(x) $\wedge$ plural(x) (or nonsingular) (Tsoulas, 2009: p. 143)

The sort of modification in (11) is freely able to occur on mass nouns, unlike semantic pluralization, which would be redundant on a mass noun that already denotes an atomic semi-lattice.

Chierchia (2015) formalizes the difference between Greek and English with respect to number marking in a different manner. In Chierchia's (2015) most recent analysis of number marking and the mass/count distinction across languages, he assumes Greek number marking is weak, and therefore allows plural mass nouns, while English number marking is strong, and therefore does not allow plural mass nouns. Weak number marking is that in which the *-operator (12), plural predicates, and singular predicates, (14), are all defined with respect to a non-modal notion of atomicity, (13). These atoms are entities in the denotation of a predicate, in world *w*, which have no parts that are also in the denotation of the predicate.

(12) *: $\lambda w \lambda x \exists Y[Y \subseteq AT(P)_w \wedge = \sqcup Y]$ (Chierchia, 2015: p. 155)

(13) $AT(P) = \lambda w \lambda x[P_w(x) \wedge \forall z[P_w(z) \wedge z \leq x \rightarrow z = x]]$ (Chierchia, 2015: p. 155)

(14) a. $SG(P) = P$ if $\forall w\ \forall x\ [P_w(x) \rightarrow \forall z[P_{w'}(z) \wedge z \leq x \rightarrow z = x]]$[2]
b. $PL(P) = P$ if $*P = P$ (Chierchia, 2015: p. 164)

For Chierchia (2015), Greek mass nouns refer to (unstable) minimal quantities of the entities in the denotation of the noun. An unstable minimal quantity, or atom, is that which may be an atom with respect to a predicate in one world, but not in all accessible worlds as in (15).

(15) $MASS.(P) = \forall w\ \forall x\ [P_w(x) \wedge \forall z[P_w(z) \wedge z \leq x \rightarrow z=x] \rightarrow \neg\Box\forall y[P(y) \wedge y \leq x \rightarrow y=x]]$
If x is a P-atom in w it is consistent with what is known in w that x may be a plurality of smaller Ps. (Chierchia, 2015: p. 159)

English, on the other hand, has strong number marking, (16), which is defined with respect to a stronger, modal notion of atomicity, namely the definition of stable atoms. An atomic predicate, (17), is one whose atoms are atoms in in every accessible world.

(16) a. $PL(P)=P$ if $*AT(P)=P$
b. $SG(P)=P$ if $AT(P)=P$ (Chierchia, 2015: p. 164)

(17) $AT(P) = \lambda w \lambda x[P_w(x) \wedge \forall w' \in K_w \forall z[P_{w'}(z) \wedge z \leq x \rightarrow z=x]]$ (Chierchia, 2015: p. 161)

Because this definition of number marking requires singular nouns to denote stable atoms, but mass nouns denote unstable atoms, (15), Chierchia (2015) assumes that English encodes mass nouns as a singleton property, namely the maximal plural individual that results from the closure of unstable minimal entities under '$\sqcup$ via the *-operator. The same cannot happen in Greek, however, since singular nouns, by definition, are not stably atomic.

The assumption that Greek number marking is weak results in the predication that mass nouns can straightforwardly take plural morphology, just like count nouns, resulting in the closure under sum of (unstable) atoms. This analysis also predicts that Greek should have no object

[2] I assume that the prime on the second P_w is a typo rather than unbound.

mass nouns, which Tsoulas (2009) reports to be the case: Greek nouns that might be object mass are, in fact, count, e.g. *epiplo* (‘piece of furniture’), *asimiko* (‘piece of silverware’), and *maheropiruno* (‘piece of cutlery’). These nouns cannot be mass, under this analysis of number marking, because object mass nouns only result as a matter of lexical choice in strong number marking languages, which have a means of encoding mass nouns a singleton properties in order to satisfy the requirement that singular nouns are stably atomic. Since Greek is not a strong number marking language and does not have a definition of singular nouns that acts as a driving force for encoding mass nouns a singleton properties, lexical choice does not occur in Greek, and object mass nouns should not exist. In sum, Chierchia’s (2015) account of number marking in Greek and English ties the existence of both plural mass nouns and object mass nouns in a particular language to the particular type of number marking that language has, weak or strong.

3.2. Alexiadou (2011, 2015) and Kouneli (2019)

Alexiadou (2011) and Kouneli (2019) both argue for a lexical approach to the analysis of plural mass nouns in Greek. They assume a lexical inference is in the literal meaning of sentences containing plural mass nouns, with (Alexiadou, 2011) arguing for a ‘much’ inference, and (Kouneli, 2019) arguing for a ‘spread/scattered’ inference. Both Alexiadou (2011) and Kouneli (2019) follow Acquaviva (2008) in assuming a split analysis of plural morphology.

Acquaviva’s (2008) split analysis involves two realizations of plural morphology, grammatical and lexical. Grammatical pluralization corresponds to semantic pluralization, such as that in Chierchia (2015), which has been widely assumed since Link (1983). The assumption is that the use of plural morphology corresponds to a semantic operation on the singular noun that results in reference to sums of individuals (and sometimes the individuals themselves depending on whether or not an inclusive or exclusive analysis of the plural is being argued for). Lexical pluralization, on the other hand, is the result of plural morphology combing with a root before it is nominalized, thereby encoding plurality into the meaning of the noun, though not in the sense of “many an *x*”. Lexical plurals, Acquaviva (2008) argues, belong to a class of nouns that is nuanced and varied with respect to plural meaning. This class includes nouns like *scissors*, for which plural morphology makes reference to the component parts, and it includes *brethren*, for which the irregular plural form of *brother* takes on a meaning more like *confrères* in French.

Rather than arguing that Greek number marking as a whole is different from that in English as Tsoulas (2009) and Chierchia (2015) argue, Alexiadou (2011) and Kouneli (2019) argue that Greek differs from English in having these lexical plurals that are used to refer to ‘much’ or ‘spread/scattered’ respectively. By not tying plural mass nouns in Greek to semantic plurality, or singular number marking, Alexiadou (2011) and Kouneli (2019) make no commitment to a relationship between plural mass nouns and object mass nouns in Greek.

Alexiadou (2015) shows there is reason to believe Greek does, in fact, have object mass nouns. *Epiplosi* (‘furniture’), for example, can refer to one or more objects without plural morphology, (18), and it can felicitously be modified by stubbornly distributive predicates, (19), thereby showing it denotes objects (Schwarzschild, 2011; Rothstein, 2010).

(18) Agorasa kenuria epiplosi ja to grafio mu
bought-1SG new furniture for DEF office my
I bought new furniture for my office. (Alexiadou, 2015: p. 14)

(19) I epiplosi sto domatio ine strogili.
the furniture in room is round
'The furniture in the room is round.' (Alexiadou, 2015: p. 15)

Alexiadou (2015) provides a morphosyntactic analysis of object mass nouns in Greek using Distributional Morphology. Following Harley (2005) roots can be categorized into ontological types—e.g. things/entities and states—and following Borer (2013) affixes categorize—e.g. nominalize roots—and carry semantic content as well (Borer, 2013). Words are formed by category defining heads—e.g. n (N) or v (verb)—in two ways: (i) they combine directly with a root—e.g. root nominalization—or (ii) they occur with a stem—e.g. deverbal nominalization (20).

(20) $[_{nP}$ m $[_{v}$ iz $[_{\surd}$ ruh $]]]$ *rohismos* ('clothing') (Alexiadou, 2015: p. 19)

Object mass nouns are therefore interpreted as a collectivity of entities or a bundled aggregate, e.g. (20). As collectivities/bundles, object mass nouns cannot be individuated, meaning they cannot serve as input to morphosyntax where individuation is assumed to occur—e.g. they cannot take grammatical plural morphology. This analysis of object mass nouns in Greek, not being tied to number marking, is therefore compatible with the lexical approach to plural mass nouns in Greek, argued for by both Alexiadou (2011) and Kouneli (2019).

3.3. Kane et al. (2015)

Kane et al. (2015) aim to provide a proof of concept for a scalar implicature based approach to the meaning of plural mass nouns in Greek. While they follow the approach to scalar implicature of Spector (2007), it is meant to be compatible with other approaches as well. Kane et al. (2015) argue that a scalar implicature based approach is preferable to the lexical approach (Alexiadou, 2011) where the inference is encoded directly in the noun. The problem with the lexical approach is that, while positive statements with plural mass nouns are equivalent to those with, e.g. 'much', explicitly stated, negative statements, conditionals, and questions are not. For example, *nera* ('waters') in (21), is argued to be equivalent to *much water* by Alexiadou (2011).

(21) O Yanis ehise nera.
'John spilled waters.'
$\rightsquigarrow$ *John spilled much water.* (Kane et al., 2015: p. 328)

This equivalency does not hold, however, in downward entailing environments such as the negative statement in (22), where it cannot be the case that John spilled even a little water, which would be true if the utterance were actually "John didn't spill much water".

(22) O Ynis den ehise nera.
'John didn't spill waters'
$\not\rightsquigarrow$ *John didn't spill much water.*
$\rightsquigarrow$ *John didn't spill any water.* (Kane et al., 2015: p. 328)

Kane et al. (2015) show that the existence of the inference in upward entailing environments and its disappearance in downward entailing environments parallels the exclusive inference on plural count nouns. In (23), *giraffes* is interpreted as an exclusive plural, meaning that John saw two or more giraffes.

(23) John saw giraffes.
$\rightsquigarrow$ *John saw two or more giraffes.* exclusive reading (Kane et al., 2015: p. 326)

In the negative statement in (24), however, *giraffes* must be interpreted as an inclusive plural meaning that John cannot have seen even one giraffe.

(24) John didn't see giraffes.
$\not\rightsquigarrow$ *John didn't see two or more giraffes.*
$\rightsquigarrow$ *John didn't see one or more giraffes.* inclusive reading (Kane et al., 2015: p. 326)

Because the 'much' inference of plural mass nouns patterns with the exclusive inference associated with plural count nouns, Kane et al. (2015) analyze the former as arising via the same mechanism as the latter, namely scalar implicature based on exhaustification of alternatives, (25), where the competitors are $\{\text{PL, SG}\}$; $\{\text{SG}_{COUNT}$, two or more $\}$; $\{\text{SG}_{MASS}$, much $\}$. Exhaustification negates and excludes alternative utterances derived from competitor sets.

(25) $[\![\text{EXH}p]\!]^w = [\![p]\!]^w \forall q \in \text{EXCL}(p, Alt(p))[\neg[\![p]\!]]^w$
$\text{EXCL}(p,X) = \{q \in X : p \nsubseteq q \wedge \neg\exists r[(p \wedge \neg q) \subseteq r]\}$ (Kane et al., 2015: p. 325)

According to Kane et al. (2015), the interpretation of the the plural mass noun in (21) beings with the assumption that it is equivalent to the singular, which is paraphrased in English along with its alternatives in (26). Exhaustification of the singular leads to the interpretation in (27).

(26) $\text{Alt(John spilled water)} = \left\{ \begin{array}{l} \text{John spilled water} \\ \text{John spilled much water} \end{array} \right\}$ (Kane et al., 2015: p. 328)

(27) $[\![\text{EXH}]\!]^w(\text{John spilled water}) = [\![\text{John spilled water}]\!]^w \wedge \neg[\![\text{John spilled much water}]\!]^w$
$= [\![\text{John spilled little waters}]\!]^w$ (Kane et al., 2015: p. 328)

The plural sentence is doubly exhaustified, (28), resulting in a 'much' inference.

(28) $[\![\text{EXH}]\!]^w([\![\text{EXH}]\!]^w(\text{John spilled waters})) =$
$[\![\text{John spilled waters}]\!]^w \wedge \neg[\![\text{John spilled little water}]\!]^w =$
$[\![\text{John spilled much waters}]\!]^w$ (Kane et al., 2015: p. 328)

Semantically, Kane et al. (2015) assume that singular count nouns denote atomic individuals, plural count nouns denote atoms and sums thereof, and mass nouns are inherently semantically plural, denoting atoms and sums thereof. Following Chierchia (2010), they assume that mass noun atoms are unstable thereby distinguishing them from plural count nouns. Kane et al. (2015) assume that plural morphology corresponds to the closure of individuals under sum, explaining the correspondence of plural count nouns to singular count nouns. However, because mass nouns are inherently semantically plural, the closure under sum associated with morphological pluralization is semantically redundant on mass nouns. At the same time, however, pluralization triggers a scalar implicature on both count nouns and mass nouns, where the inference associated with count nouns is 'two or more' and the inference associated with mass nouns is 'much'.

3.4. Discussion of previous analyses

The analyses of Tsoulas (2009); Chierchia (2015); Kane et al. (2015); Alexiadou (2011, 2015) and Kouneli (2019) are each able to answer some of the questions that have been raised regarding plural mass nouns in Greek, though other questions are left unanswered.

The approaches of Tsoulas (2009) and Chierchia (2015), for example, distinguish Greek number marking as weaker than that of English, answering the question why Greek has plural mass nouns while English does not. Chierchia (2015), however, provides no account of the inference associated with plural mass nouns, and neither Chierchia (2015) nor Tsoulas (2009) address the contextual restrictions on when plural mass nouns are (not) appropriate. Furthermore, these approaches predict that Greek has no object mass nouns, which might be unwanted given Alexiadou's (2015) argument that Greek has object mass nouns.

The approaches of Alexiadou (2011) and Kouneli (2019) distinguish plural mass nouns in Greek as lexical plurals that simply do not occur in languages like English. The inference is accounted for as part of idiosyncratic meaning of this type of lexical plural, either meaning 'much' (Alexiadou, 2011) or 'spread/scattered' (Kouneli, 2019). The fact that a singular mass noun and its lexically plural counterpart are fundamentally two different nouns that share a common root can address the contextual challenge, via the respective lexical semantics of the nouns. This sort of approach, however, does not seem compatible with the evidence from Kane et al. (2015), that the inference disappears in downward entailing contexts.

The scalar implicature approach of Kane et al. (2015) straightforwardly accounts for when an inference accompanies plural mass nouns and when it disappears. The semantic basis of this account, however, requires morphological pluralization to be semantically redundant on mass nouns, though this does serve to characterize the distinction between Greek and English, though it is unclear why Greek would accept this redundancy and English would not. Lastly, is unclear how Kane et al. (2015) would account for the contextual restrictions on plural mass nouns, namely that a 'much' inference might occur on when describing rice scattered across a pan after a meal, but not when the pan is full of rice before the meal begins.

4. Proposal

In this section I motivate a novel approach to the analysis of plural morphology in Greek to account for the accompanying inference and contextual restrictions on usage. I argue that Greek plural morphology involves a context sensitive measure function, which is similar in spirit to the analysis of English count nouns by Grimm (2013), who builds on the analysis of nouns by Krifka (1989, 1995) in which count nouns are measured for cardinality of individuals. Extending this to Greek, the idea that will be developed in this section is that mass nouns are measured for *magnitude*—i.e. size/extent. This is meant to capture the notion of 'spread/scattered' (Kouneli, 2019) as opposed to, e.g. volume, which is insufficient given the relevant data.

I build this analysis on Filip & Sutton's (2017) semantic analysis of nouns in which lexical entries are ordered tuples (Landman, 2016; Sutton and Filip, 2016a). The different parts of the tuple represent different aspects of the meaning of nouns, and motivate their combinatorial properties, e.g. counting and pseudo-partitive constructions. This context sensitive analysis of the mass/count distinction provides the necessary criteria, namely the formalization of compositional preconditions and sufficiently rich lexical structures, to build a measure based analysis of plural nouns that accounts for the Greek data.

4.1. Measure based plurals

Grimm (2013) reviews the main arguments for the scalar implicature approach to plurals and produces evidence and arguments against such an approach. As an alternative, he argues for a Question Under Discussion (QUD) based approach to the analysis of plural nouns, that builds on the analysis in Krifka (1995). Grimm (2013) argues that exclusive and inclusive readings of plural nouns are due to whether the immediate Question Under Discussion (QUD) is concerned with a number of concrete entities greater than or equal to two and therefore exclusive, or concerned with the type of thing named and therefore an inclusive, generic interpretation. The data supporting this argument includes Negative Polarity Item (NPI) licensing environments and others that aren't downward entailing yet nevertheless get inclusive interpretation, which is not predicted to be the case according to previous analyses of the interpretation of plural predicates. The analysis builds on the analysis of nouns in Krifka (1995) and the structure of discourse in Roberts (1996).

Grimm (2013) argues against the recent analyses of plural interpretation and in favor of his own with data that shows the inclusive interpretation is sometimes available in NPI-licensing environments and environments that aren't downward entailing, and therefore not strictly a matter of scalar reasoning.

(29) Sherlock Holmes should question local residents to find the thief. (Grimm, 2013)

(30) I am looking for houses to try to find someone to give us directions.

In both of the above examples, the plurals get inclusive interpretation though they are not downward entailing environments. In neither case does the subject require the object to denote sums if it turns out that the first individual meeting the description satisfies the rest of the context. The case is similar for NPIs, which also do not align with inclusive interpretation.

(31) a. I am surprised that anything was there. [NPI OK]
b. I am surprised that boxes were in the office. [exclusive plural only]

(32) a. #Both students who saw *anybody* reported to the police. [NPI not OK]
b. Both students who saw *spies* reported to the police. [inclusive plural]
(Grimm, 2013)

If inclusive plurals aligned with NPIs, then it should not be the case that the data above are true. Given that inclusive readings fail to align with downward entailing environments and NPI-licensing environments, Grimm (2013) argues that inclusive plurals do align with generic interpretations. He supports this arguments with experimental evidence in which participants are seen to more strongly prefer inclusive interpretations in generic constructions while exclusive interpretations are preferred in existential constructions.

Grimm's (2013) formal analysis builds on Krifka (1995) in respect to the denotation of nouns and it builds on Roberts (1996) in respect to the structure of discourse. From Krifka (1995), Grimm (2013) builds on the idea that nouns make reference to concepts via the realization relation, R_i, objects via the OU_i function, and number, where i is a variable of type s ranging over possible worlds:

(33) $$\lambda y.\lambda i.\lambda n.\lambda x.[\mathrm{R}_i(x,y) \wedge \mathrm{OU}_i(y)(x) \; = \; n]$$ (Grimm, 2013)

The difference between the quantified object and instances of a concept, then is whether or not n takes a specific number. If n is ≥ 2 then the noun references a quantified object and the interpretation is exclusive. If n is not specified, rather it is under existential quantification, then the noun references an instance of a concept and the interpretation is inclusive.

(34a) $[\![\text{dogs}]\!] := \lambda i.\lambda x.[\mathrm{R}_i(x, DOG) \wedge \mathrm{OU}_i(DOG)(x) \geq 2]$

(34b) $[\![\text{dogs}]\!] := \lambda i.\lambda x.\exists n[\mathrm{R}_i(x, DOG) \wedge \mathrm{OU}_i(DOG)(x) = n]$ (Grimm, 2013)

Whether *dogs* gets an exclusive or inclusive interpretation depends on which QUD is assumed, following the theory of discourse in Roberts (1996). This QUD based approach allows both existential and generic interpretations of *Ed saw dogs*, polar interrogatives, conditionals, sentences under negation. Grimm (2013) also assumes that the answers to the QUD are strongly exhaustive since the meaning of a question, ?*p*, is given by a partition theory of questions (Groenendijk and Stokhof, 1984). In (35), the positive statement corresponds to the QUDs in (a.) and (b.), and the Quantitative QUD is assumed in a situation where reference to particular entities is determined.

(35) Ed saw dogs.
  a. Did Ed see dogs? (Existential QUD)
     $?(\lambda i \exists x \exists n[\text{Ed see } x \textit{ in } i \wedge R_i(x, DOG) \wedge OU_i(DOG)(x) = n])$
  b. Did Ed see dogs? (Quantitative QUD)
     $?(\lambda i \exists x[\text{Ed see } x \textit{ in } i \wedge R_i(x, DOG) \wedge OU_i(DOG)(x) \geq 2])$ (Grimm, 2013)

For negative statements, the Existential QUD is assumed because it is consonant with denying the existence of entities designated by the noun.

(36) Ed didn't see dogs.
  a. *Existential QUD*: Did Ed see any dogs?
  b. ?*Quantitative QUD*: Did Ed see a plurality of dogs? (Grimm, 2013)

This approach to the readings of plural nouns accommodates the inferences associated with count nouns, but it is unclear exactly how the inferences associated with plural mass nouns would be accommodated in this system. In particular, for Krifka (1995) the interpretation of mass nouns is not relational and therefore cannot be applied to numbers.

4.2. Counting, measuring, and quantization

Filip and Sutton (2017) present an account of the mass/count distinction that can capture the distribution of nouns in measure phrases. This is achieved, in part, by combining elements of the proposals by Sutton and Filip (2016a, b) and Landman (2011, 2016), who treat the lexical entries of nouns as ordered pairs whose parts motivate the combinatorial properties of nouns. For Filip and Sutton (2017), lexical entries of nouns consist of tuples of the kind ⟨**extension, c_base$_P$, preconditions**⟩ as in (37). The first slot of the tuple is a predicate for the extension of the noun, and the second slot contains a predicate for the counting base of the noun, which specifies the individuals that can be counted relative to a particular counting schema. The third slot contains preconditions for composition, such as the restriction of Krifka (1989) that requires non-quantized predicates in extensive measure phrases.

The lexical entries of substance and object nouns are semantically distinguished, by Filip and Sutton (2017); Sutton and Filip (2016a, b), with an individuation function, $\mathbf{IND}_{\langle\langle e,t\rangle,\langle e,t\rangle\rangle}$, which identifies countable individuals. In (37a) **IND**(CAT) identifies all objects counted as an individual cat, while **IND** is omitted from (37b) because **IND**(MUD) is null given it does not denote objects. Such a distinction is supported by the ability of pre-linguistic infants to distinguish substances from objects (Soja et al., 1991).

(37a) $[\![\textit{cats}]\!]^{c_i} = \lambda x.\langle {}^{*}c_i(\textbf{IND}(\text{CAT}))(x),\ \lambda y.c_i(\textbf{IND}(\text{CAT}))(y),\ \varnothing \rangle$

(37b) $[\![\textit{mud}]\!]^{c_i} = \lambda x.\langle {}^{*}c_0(\text{MUD})(x),\ \lambda y.c_0(\text{MUD})(y),\ \varnothing \rangle$

The predicates CAT and MUD are number-neutral predicates, which stand in for bundles of properties, perceptual, functional, and otherwise.

The $c_{\langle\langle e,t\rangle,\langle e,t\rangle\rangle}$ function in nominal lexical entries identifies individuals to be counted according to a certain schema. *Specific counting schemas*, c_i, denote maximally disjoint subsets of individuals, and the *null counting schema*, c_0, denotes a set of all, possibly overlapping individuals. The specification of both counting schema and individuation are both necessary to account for, among other things, why it is the case that a noun like *fence* can straightforwardly occur in both counting constructions and pseudo-partitive measure DPs, while a noun like *cat* cannot. In counting constructions, numericals denote numerals and require modification to directly combine with nouns. This modifying function *MOD* contains the precondition that the noun to be counted has a quantized counting base. Following Krifka (1989, 1995), a predicate is quantized iff it holds of something but not of that thing's proper parts.

(38) QUANTIZED P : $\forall P[\text{QUA}(P) \leftrightarrow \forall x \forall y[P(x) \wedge P(y) \rightarrow \neg(x \sqsubset y)]]$ (Krifka, 1989: p. 78)

Interpreted at a specific counting schema, c_i, both *fence* and *cat* have disjoint counting bases. Counting constructions are composed as in (39).

(39a) $[\![\text{three}]\!]^{c_i} = 3$

(39b) $\text{MOD} = \lambda n.\lambda P.\lambda x.\langle \pi_1(P(x)),\ \mu_{card}(x, \pi_2(P(x)) = n,\ \text{QUA}(\pi_2(P(x)))\rangle$

(39c) $\text{MOD}([\![\text{three}]\!]^{c_i}) = \lambda P.\lambda x.\langle \pi_1(P(x)), \mu_{card}(x, \pi_2(P(x)) = 3, \text{QUA}(\pi_2(P(x)))\rangle$

(39d) $[\![\text{fences}]\!]^{c_i} = \lambda x.\langle {}^{*}c_i(\textbf{IND}(\text{FENCE}))(x),\ \lambda y.c_i(\textbf{IND}(\text{FENCE}))(y), \varnothing\rangle$

(39e) $[\![\text{three fences}]\!]^{c_i} = \text{MOD}([\![\text{three}]\!]^{c_i})([\![\text{fence(s)}]\!]^{c_i}) =$
$\lambda x.\langle {}^{*}c_i(\textbf{IND}(\text{FENCE}))(x), \mu_{card}(x, \lambda y.c_i(\textbf{IND}(\text{FENCE})(y)) = 3,$
$\text{QUA}(\lambda y.c_i(\textbf{IND}(\text{FENCE}))(y))\rangle$ (Filip and Sutton, 2017: p. 352)

In pseudo-partitive measure DPs, which apply the null counting schema to the nominal argument, *fence* has a non-quantized extension, while *cat*, which denotes the same, countable individuals in every counting schema, still has a quantized extension and is therefore infelicitous. The idea is that what counts as one fence varies from schema to schema (Rothstein, 2010): while the fencing surrounding a rectangular property could be counted as one fence according to one schema, it could be counted as four fences according to another schema. The null counting schema, therefore denotes a set of overlapping individuals. This sort of null schema is not quantized and is a precondition for composition in pseudo-partitive measure DPs:

(40a) $[\![\text{three}]\!]^{c_i} = 3$

(40b) $[\![\text{meters of}]\!]^{c_i} = \lambda n.\lambda P.\lambda d.\lambda x.$
$\langle \pi_1(P(c_0)(x)),\ \mu_m(x,d) = n,\ \neg\text{QUA}(\lambda y.\pi_1(P(c_0)(y)))$

(40c) $[\![\text{fence}]\!] = \lambda c.\lambda x.\langle c(\mathbf{IND}(\text{FENCE}))(x),\ \lambda y.c(\mathbf{IND}(\text{FENCE}))(y),\ \varnothing\rangle$

(40d) $[\![\text{three meters of fence}]\!]^{c_i} = [\![\text{meters of}]\!]^{c_i}([\![\text{three}]\!]^{c_i})([\![\text{fence}]\!]) = \lambda d.\lambda x.$
$\langle c_0(\mathbf{IND}(\text{FENCE}))(x), \mu_m(x,d) = 3,\ \neg\text{QUA}(\lambda y.c_0(\mathbf{IND}(\text{FENCE}))(y))\rangle$

(Filip and Sutton, 2017: p. 353)

This analysis of nominal structure is able to account for why nouns like *cat* are countable but cannot occur in pseudo-partitive measure DPs without a shift. This shows that quantization is useful for distinguishing different measurable properties, and that rich lexical structures are necessary to straightforwardly capture the distribution of nouns across different DPs.

4.3. Measure based plural nouns in Greek

The analysis of Greek number marking proposed here combines the lexical structure of nouns from Filip and Sutton (2017) and the approach to the interpretation of plurality in Grimm (2013). Extending the analysis of English singular nouns in Filip and Sutton (2017) to Greek, the lexical entries of *gata* ('cat') and *laspi* ('mud') resemble their English counterparts with respect to countability.

(41a) $[\![\textit{gata}]\!]^{c_i} = \lambda x.\langle c_i(\mathbf{IND}(\text{CAT}))(x),\ \lambda y.c_i(\mathbf{IND}(\text{CAT}))(y),\ \varnothing\rangle$

(41b) $[\![\textit{laspi}]\!]^{c_i} = \lambda x.\langle {}^*c_0(\text{MUD})(x),\ \lambda y.c_0(\text{MUD})(y),\ \varnothing\rangle$

Greek plural morphology builds on the denotations of all singular nouns in the same way, (42). The *qualities* slot of plural morphology selects that of the singular noun via the projection function π_1 and closes it under sum with the *-operation, though without specifying atoms as done by Chierchia (2015), because, following Filip and Sutton (2017); Sutton and Filip (2016a); Landman (2016); Krifka (1989), a non-atomic mereology is assumed. The c_base_P of the plural noun is identical to that of the singular via the projection function π_2. The preconditions slot contains a function that measures the singular noun's counting base.

(42) $[\![\text{PL}]\!] = \lambda P.\lambda x.\langle {}^*\pi_1(P(x)),\ \pi_2(P(x)), \mu_{PL}(x.\lambda y.\pi_2(P(x)(y))) > n_k\rangle$

(43a) $[\![\textit{gates}]\!]^{c_i} = \lambda x.\langle {}^*c_i(\mathbf{IND}(\text{CAT}))(x),\ \lambda y.c_i(\mathbf{IND}(\text{CAT}))(y),$
$\mu_{PL}(x.\lambda y.c(\mathbf{IND}(\text{CAT}))(y)) > n_k\rangle$

(43b) $[\![\textit{laspes}]\!]^{c_i} = \lambda x.\langle {}^*c_0(\text{MUD})(x),\ \lambda y.c_0(\text{MUD})(y),$
$\mu_{PL}(x.\lambda y.c(\mathbf{IND}(\text{MUD}))(y)) > n_k\rangle$

Similar to the analysis proposed by Kane et al. (2015) the extension of mass nouns is already closed under sum, (41b), so the *-operation in the definition of plural morphology, (42), is redundant on mass nouns. However, instead of prompting a scalar implicature as in the account of Kane et al. (2015), in the present account, plural morphology carries the precondition that the counting base is greater than a contextually specified amount n_k.

While the idea of the measure function can be uniformly applied to both count and mass nouns in Greek, the difference in denotation and interpretation between the two classes of nouns requires further specification of exactly what is being measured. Following Krifka (1989, 1995) and Grimm (2013), count nouns are measured for cardinality of countable individuals. The way that mass nouns are measured, however, is not as straightforward. A simple measure of surface area or volume of the substance will not suffice because an amount of sand in pile does not necessarily sanction the use of the plural mass noun, while that same amount scattered across a floor is enough. Instead, the size or extent of the substance in a certain context is the relevant dimension, which I will gloss as MAGNITUDE, intending to capture the 'spread/scattered' sense argued for by Kouneli (2019). The plural measure function, μ_{PL}, therefore, is sensitive to whether the counting base is quantized.

(44)
$$\mu_{PL} = \begin{cases} \text{QUA}(\pi_2(P(x))) & \rightarrow & \mu_{CARDINALITY} \\ & else & \mu_{MAGNITUDE} \end{cases}$$

Sensitivity to quantized counting bases prevents magnitude measurement of count nouns like *gates* ('cats'), and it prevents infelicitous cardinality measurement of mass nouns like *laspes* ('muds'). With the specification in (44), the lexical entries of *gates* ('cats') and *laspes* ('muds') can be further specified:

(45a)
$$[\![gates]\!]^{c_i} = \lambda x.\langle {}^{*}c_i(\textbf{IND}(\text{CAT}))(x),\ \lambda y.c_i(\textbf{IND}(\text{CAT}))(y), \\ \mu_{CARDINALITY}(x,\ \lambda y.c_i(\textbf{IND}(\text{CAT})(y))) > n_k\rangle$$

(45b)
$$[\![laspes]\!]^{c_i} = \lambda x.\langle {}^{*}c_0(\text{MUD})(x),\ \lambda y.c_0(\text{MUD})(y), \\ \mu_{MAGNITUDE}(x,\ \lambda y.c_0(\text{MUD}(y))) > n_k\rangle$$

Crucially, with analysis of the semantic contribution of morphological pluralization, because the counting base of count and mass nouns remain unchanged, the analysis of counting in Filip and Sutton (2017) can be upheld. This means that plural mass nouns are still mass and cannot be counted.

5. Discussion

As has been seen in the background of Greek data, the interpretation of a plural noun varies depending on the context of its use: a plural count noun might get an inclusive or exclusive reading, and a plural mass noun might get an inclusive reading or a spread/scattered reading. While Kane et al. (2015) analyzed these interpretations as the result of scalar implicature, Grimm (2013) argued for a QUD based approach to the interpretation of plural count nouns in English. By building a measure function into the lexical entries of both count and mass nouns in Greek, it is possible to specify the amount measured in a given context, n_k, with the QUD based approach argued for by Grimm (2013).

If plural noun gets an inclusive reading, then it is the case that a Existential QUD has been assumed, asking about any amount greater than zero, $n_k = 0$. If a plural count gets an exclusive reading, then a Quantitative QUD is assumed, asking if the cardinality is larger than one, $n_k = 1$. If a plural mass noun gets a spread/scattered reading, the assumed Quantitative QUD is asking if the magnitude is large enough to warrant the use of plural in that particular context. These amounts cannot be straightforwardly specified in terms of cardinality, as in the case of count nouns, rather they are determined relative to the context at hand. With respect to (9b), where *rizia* ('rices') is used to describe several grains of rice scattered across a pan, the context is the conclusion of a meal when dishes are typically expected to be empty. The question under discussion introduces a relevant magnitude, $n_{k.empty}$, that is relatively low: the magnitude of the several grains of rice scattered across the pan that should be empty is greater than $n_{k.empty}$, and it is therefore enough to sanction the use of the plural mass noun, (46). With respect to (9a), the context is the conclusion of the rice cooking when a pan is typically expected to be full of rice; the relevant magnitude, $n_{k.full}$, introduced by the QUD is relatively high, so a pan that is full of rice in the usual way is not greater than $n_{k.full}$ and therefore not enough to sanction the use of the plural mass noun, (47).

(46) Several grains of rice scattered across an empty pan.
$\mu_{PL}(x.\lambda y.c_0(RICE(y))) > n_{k.empty}$

(47) The rice in a full pan.
$\mu_{PL}(x.\lambda y.c_0(RICE(y))) \not> n_{k.full}$.

While it is unclear why the 'much' inference argued for by Tsoulas (2009); Alexiadou (2011) and Kane et al. (2015) would be appropriate for certain quantities that are smaller than others that require the singular, the context sensitivity in this QUD based approach straightforwardly accounts for it: relevant magnitudes are introduced by the QUD. Importantly, the relevant quantity for both count and mass nouns can sometimes be zero, thereby prompting an inclusive readings as in negative statements like (22). At the same time, however, the notion of magnitude, spreadedness, and/or scatteredness are relatively unclear, and future work must seek to understand the specifications of the quantities and distributions that warrant plural mass nouns in particular contexts.

5.1. Extending measure based number

Plural morphology is often assumed to correspond to the closure under sum via *, or some variation thereof (e.g. Link, 1983; Chierchia, 1998, 2010, 2015; Tsoulas, 2009; Rothstein, 2010, 2017; Kane et al., 2015). With such an approach to plural morphology, it is unclear exactly how other forms of number marking would be accommodated, such as the dual in Hebrew (48) and paucal in Avar (49).

(48)	a.	yom-ayim day-DU 'two days'	b.	yom-im day-PL 'days'	Hebrew (Corbett, 2000)
(49)	a.	nús-al daughter.in.law-PAUC 'a few daughters in law'	b.	nus-ábi daughter.in.law-PL 'daughters in law'	Avar (Corbett, 2000)

Similar to Link (1983) and Chierchia (1998) who define exclusive plurals by defining the pluralization operation as the relative complement of the denotation of a predicate in its upward closure under *, it would in theory be possible to define a series of similar operations that result in the predicate denoting only two, a few, or one entities. Extending measure based number as in (50), on the other hand, would make these morphemes look much more uniform in analysis: dual morphology would require that the counting base has a cardinality of two, and paucal morphology would require that the cardinality is smaller than a contextually specified amount. Future work is needed to see if such an analysis is, in fact, feasible in such languages.

(50a) $[\![\text{DU}]\!] = \lambda P.\lambda x.\langle {}^*\pi_1(P(x)),\ \pi_2(P(x)),\ \mu_{PL}(x.\lambda y.\pi_2(P(x)(y))) = 2 \rangle$

(50b) $[\![\text{PAUC}]\!] = \lambda P.\lambda x.\langle {}^*\pi_1(P(x)),\ \pi_2(P(x)),\ \mu_{PL}(x.\lambda y.\pi_2(P(x)(y))) < n_k \rangle$

Another instance of number marking that might be accounted for with measure based plural morphology is the often unaddressed use of plural morphology on mass nouns in English, where the mass nouns like *water*, *sand*, and *snow* take plural morphology, but do not shift to a kind or portion interpretation as in (51a)–(51c).

(51) a. Both waders immediately filled and I caught my breath as freezing April waters began to stimulate sensitive nether regions. (BNC)
b. We were in the midst of sands, brushwood, and huge pieces of rock. (OED)
c. one of the first major Alpine highways opened in 1935 to see Austria's highest mountain, set amidst the everlasting snows of the Pasterze glacier (BNC)

Examples such as these are mentioned by Acquaviva (2008), who categorizes them as lexical plurals, and by Krifka (2008), who notes that the phenomenon is not as productive as that in Greek. Recall that Alexiadou (2011) and Kouneli (2019) treat plural mass nouns in Greek as lexical plurals in the same way that Acquaviva (2008) treats examples like those in English immediately above. In these English examples, a notion of 'abundance' seems much more relevant than the notion of 'spread/scattered' recently argued for in Greek. It might be said, then, that Greek lexical plural mass nouns encode this notion of 'spread/scattered', while those in English encode abundance, but this analysis would be premature since Greek also uses mass nouns with plural morphology in the way demonstrated in the English examples above:

(52) Tzóni efthýmise anakalóntas sti mnými tou to pálai poté kinitó tou kai tin olympiakón epidóseon voutiá pou ékane sta nerá tou Saronikoú. (Corpus of Modern Greek)
'Johnny was right in recalling his dive into the waters of the Saronic Gulf.'

The lexical approach would therefore have to assume that either (i) 'spread/scattered' plural mass nouns are distinct from these 'abundance' plural mass nouns—in which case there are two distinct, but homonymous lexical plurals *nera* ('waters')—or, (ii) that both are the same sort of lexical plural, albeit with one that varies from context to context.

In a measure based approach, both options are likewise available: it might be the case that there are distinct lexical entries where the notion of what is measured is distinct when *nera* ('waters') is used with respect to water splashed around the surface of a bathtub and when it is used with respect to the water of the Saronic Gulf. Alternatively it might be that there is one lexical entry, and context is doing all of the work, determining when *nera* ('waters') is appropriate, be it when it is scattered/spread across the surface of a bath tub or the water of the Saronic Gulf. Under this approach, the English examples would also be considered plural mass nouns, and it would seem that English restricts plural mass nouns to very large amounts, those larger than lakes or gulfs, which would predict why *waters* is never used for spills or splashes, and why *honeys* and *juices* are never used as plural mass nouns—i.e. they never occur in large enough amounts to warrant the use of plural morphology. As a third alternative, it might be the most straightforward to say that these 'abundance' cases referring to the water in lakes, gulfs, etc. are lexical plurals, while the 'spread/scattered' cases are grammatical, measure based plurals. This approach would have the most potential explanatory power: English and Greek both have lexical plural mass nouns, while grammatical plurals in Greek are based on measurement and those in English are not.

6. Conclusion

This paper has discussed the feasibility of a measure based approach to plural mass nouns in Greek, as opposed to a scalar implicature or lexical plural approach. Greek plural morphology can be treated as introducing a measure function into the NP, where count and mass nouns both take the same, context sensitive plural morpheme. In this approach, it is not the case that plural morphology is straightforwardly semantically redundant on plural mass nouns, rather context sensitive measurement gives rise to contextual restrictions the use of plural mass nouns discussed by Kouneli (2019). This approach, in tandem with a QUD-based analysis of plural nouns based on Grimm (2013), provides the ability to account for inclusive and exclusive readings discussed by Kane et al. (2015). Lastly, because this approach does not tie the existence of object mass nouns to the sort of number marking in English, as done by Chierchia (2015), this analysis leaves open the possibility that Greek does have object mass nouns, as Alexiadou (2015) argues.

With respect to the three challenges posed by plural mass nouns in Greek, a measure based approach provides the following answers: (i) Greek is distinguished from English by having measure based plurality that allows plural mass nouns to be used for describing even small amounts of a given substance, (ii) the inference that plural mass nouns give rise to can be accounted for with this measure based plurality and a QUD-based analysis of the readings of plural nouns, and (iii) the certain amounts/distributions of substances that warrant the use of plural mass nouns are strictly tied to context, which this measure function is sensitive to. These answers and the alternative answers argued for by Tsoulas (2009); Alexiadou (2011); Chierchia (2015); Kane et al. (2015) and Kouneli (2019), however, each inspire more fine-grained questions: What is it about the nature of the Greek DP (or even on a larger scale) that allows for plural mass nouns to describe even small amounts of a substance? And, how can the contextual specifications and measurement of these plural mass nouns be further clarified?

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Negated definite conjunction and its implicatures[1]

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Abstract. Two different readings are possible in English when a conjunction of definite objects is negated. It is argued in the present paper that different sets of alternatives are active in the two cases, but that this is only possible with the right interplay of the preceding context and the intonation contour of the sentence. Both readings result from exhaustification. However, the number of applications of the EXH operator is different in the two cases. This fosters discussion about the constitution of alternative sets, the exact role of focus, as well as triggers for (re-)exhaustification.

Keywords: conjunction, ambiguity, stress, alternatives, exhaustification, homogeneity.

1. Introduction

Two scope-taking expressions inside one sentence usually result in ambiguity. Furthermore, when one of the two expressions is member of a Horn (1972) scale, focus-related effects are not uncommon. The case in question is VP-internal definite conjunction under negation.

1.1. Ambiguous negated conjunction in English

A sentence like (1) can have two readings. It is possible to interpret it as (2a), where it is not the case that he visited both Colombia and Brazil, so he either visited Colombia or Brazil. But it is also possible to interpret (1) as (2b) where he didn't visit either of the two countries, i.e. he didn't visit Colombia and he didn't visit Brazil.

(1) He didn't visit Colombia and Brazil.

(2) a. He didn't visit both countries, but only one of the two.
  b. He visited neither country.

The former reading (2a) is that of a conjunction in the scope of negation (3), whereas the latter logically corresponds to a conjunction that outscopes negation (4).

(3) $\neg[C \wedge B]$

(4) $[\neg C] \wedge [\neg B]$

The two readings correlate with different intonation patterns of the sentence. Stress on the connective *and* (5) is normally required for (2a), whereas the whole conjunction is stressed (6) for (2b). Negation is stressed in both patterns (5, 6), as well.

(5) He didn't$_F$ visit Colombia and$_F$ Brazil $\neg[C \wedge B]$

(6) He didn't$_F$ visit [Colombia and Brazil]$_F$ $[\neg C] \wedge [\neg B]$

[1] I would like to thank Nina Haslinger, Marie-Christine Meyer, Viola Schmitt, and especially Clemens Mayr for helpful discussion and useful feedback. All remaining errors are, of course, mine.

The major parameter thus seems to be whether secondary stress is placed on the connective *and* (5) or on the whole conjunction as a coordinated constituent (6). Unsurprisingly, the two intonation patterns are compatible with different continuations. Namely, when the stress is placed on the connective, the sentence is naturally followed by either an assertion of one (7a) or the other (7b) country having been visited. However, it is not felicitous to bring up a third, so far unmentioned country (7d) as a follow-up, or to ask a verification question about neither of the two countries having been visited (7e)[2].

(7) He didn't visit Colombia and$_F$ Brazil
  a. ✓... He visited (only/just) Colombia.
  b. ✓... He visited (only/just) Brazil.
  c. ✓... He visited either Colombia or Brazil, but I'm not sure which one he picked in the end.
  d. # ... He visited Peru.
  e. # Are you saying that he visited neither?

Conversely, when the whole conjunction is stressed (8), asserting that he visited only Colombia (8a) or only Brazil (8b) is infelicitous, whereas a continuation containing an alternative that is not found in either of the conjuncts (Peru in (8c)) or a hint at neither of the two countries being visited (8d) is now compatible with the initial utterance (8).

(8) He didn't visit [Colombia and Brazil]$_F$
  a. # ... He visited (only/just) Colombia.
  b. # ... He visited (only/just) Brazil.
  c. ✓... He visited Peru.
  d. ✓Are you saying that he visited neither?

Such complementary continuations demonstrate that the two readings of negated conjunction are distinct and attestable independently from each other, even though an entailment relation exists between them: taken at face value, the strong, 'neither' reading (2b/4/6) entails the weak, 'not both' one (2a/3/5). A question emerges immediately: should the two readings be analyzed as two scopal orderings of conjunction with respect to negation (narrow in (2a)/(3) and wide in (2b)/(4))? The latter pattern (8) is, in fact, often identified as a product of a Homogeneity inference (Fodor, 1970; Löbner, 1987) of the form 'either he visited Brazil and he visited Colombia, or he didn't visit Brazil and he didn't visit Colombia', whereas stress on *and* (7) is brought into relation with *both* (Schein, 1986; Schwarzschild, 1994; Szabolcsi and Haddican, 2004), in charge of eliminating Homogeneity.

1.2. Alternatives and stress

Conjunction is a strong scalar element (9), and for this reason not associated with scalar inferences when appearing in Upward-Entailing (UE) environments (Chierchia, 2004).[3]

[2]For the 'Are you saying that ϕ?'-test see Meyer (2013).

[3]A UE environment licenses inferences from sets to supersets, for ex. *He drank maté.* $\Rightarrow$ *He drank tea.*

(9) < or, and > Horn scale

Namely, a positive episodic sentence containing a conjunction, such as (10), asymmetrically entails its minimal pair with a disjunction (11). Moreover, (10) also asymmetrically entails its individual conjuncts, the two sentences in (12).

(10) He visited Colombia and Brazil. $C \wedge B$

(11) He visited Colombia or Brazil. $C \vee B$

(12) a. He visited Colombia. C
b. He visited Brazil. B

In some nomenclatures (Chierchia, 2013), the former (11) would correspond to 'scalar alternatives' (due to lexical substitution), whereas the latter (12) correspond to the so-called 'subdomain alternatives' (due to structural derivation) to an assertion like (10). Now, when the conjunction is found in a Downward-Entailing (DE) environment[4], like the scope of negation in (13), it no longer logically entails its scalar (14) or its subdomain (15) alternatives.

(13) He didn't visit Colombia and Brazil. $\neg[C \wedge B]$

(14) He didn't visit Colombia or Brazil. $\neg[C \vee B]$

(15) a. He didn't visit Colombia. $\neg C$
b. He didn't visit Brazil. $\neg B$

The conjunction is thus predicted to give rise to certain inferences when appearing in DE environments, although in its basic meaning *and* represents a strong element (9). As introduced in the preceding section (1.1), sentences like (13) seem to allow for two distinct interpretations, and stress placement (16) is a discriminating factor.

(16) a. He didn't$_F$ visit Colombia and$_F$ Brazil 'not both'
b. He didn't$_F$ visit [Colombia and Brazil]$_F$ 'neither'

F-marking is known to activate alternatives of the kinds exhibited in (14, 15) (Rooth, 1985, 1992; Krifka, 2007). Once alternatives are active, enrichment of the overall meaning ensues, through a purely pragmatic mechanism or syntactic, operator-driven exhaustufication. Such an enrichment could then be the source of the two attested readings.

1.3. Empirical and theoretical issues

The aim of the present paper is to address the following questions.

1. What are the requirements of the two readings of negated definite conjunction with respect to contextual input?
2. In which way do intonation patterns condition the sets of alternatives?

[4]A DE environment licenses inferences from sets to subsets, for ex. *He didn't drink tea.* $\Rightarrow$ *He didn't drink maté.*

3. What kind of meaning enrichment produces the two readings of negated definite conjunction?

It is observed that necessary antecedents of the two prosodic patterns, and therefore the two readings, are not the same – in one case the conjunction has to be previously made salient, whereas in the other previous mentioning of the individual conjuncts suffices. F-marking activates alternatives, and I will argue that its position determines their form: a scalar alternative is activated by the stress on the connective, whereas subdomain alternatives are activated either by default or by the presence of stress on the whole coordination. Obligatory exhaustification is the mechanism which derives both readings of negated definite conjunction in English. A silent operator EXH is employed with this purpose in both cases. The differences in derivation of the 'not both' and the 'neither' readings lie in the kind of alternatives that are supplied to the EXH operator and the number of applications of the latter. When stress is placed on the connective, the scalar alternative with disjunction is activated and the result of one round of exhaustification is the 'not both' meaning. Conversely, when stress is placed on the entire coordination, it is the subdomain alternatives that become active, and two rounds of exhaustification eventually yield the strengthened, 'neither of the two', meaning. The latter pattern thus represents an implicature-based account of Homogeneity, building on the proposal in Magri (2014) and modifying it. The dichotomy between the two patterns of negated definite conjunction in my account rests on scalar and subdomain alternatives not being available simultaneously. Finally, it is important to point out that only these two intonation patterns are investigated here, limited by the scope of the present paper. Other combinations are, of course, conceivable, but they will have to be left for future research.

The paper is structured as follows. The pattern with stress on the connective *and*, with its implications, is discussed in section 2. The pattern with stress on the coordination, including the derivation of the corresponding reading, is presented in section 3. Relevant predecessors in the literature on conjunction and homogeneity, as well as alternatives and (re-)exhaustification, are presented in section 4. A discussion of problems for the existing proposal, with some more general theoretical considerations, is provided in section 5, together with conclusions.

2. Stress on the connective

The pattern with stress on the connective comprises two occurences of pitch accent: high pitch accent (H*) on the finite verb which carries the negative marker (*didn't* in (17)), and a secondary, fall-rise accent (L+H*) on *and*.[5] The prosodic unit ends with a low phrase accent ('L-') and a low boundary tone ('L%').

(17) He didn't*H** visit Colombia and*L+H** Brazil*L-L%*

This intonation pattern represents contrastive negation of the conjunction, and the latter ought to be present in the preceding discourse, as I will show now.

[5] The prosodic transcription is made in ToBI notation, where 'H' represents a high, and 'L' a low tone. '*' signals that the tone in question is a pitch one, as opposed to boundary tones marked by '%'.

2.1. Preceding context

A negated conjunction with a rise-fall-rise contour cannot be uttered out of the blue. It also cannot follow just any disocurse. The negated conjunction must be made salient in its positive form in the preceding context.

2.1.1. Example of a felicitous discourse

Scenario: *John decided to take some time off and go backpacking in the Americas. His friend Sue has travelled to virtually every country in the Americas, so she advised John while he was planning his trip. Bill and Mary are also John's friends, they know his interests and preferences, but did not get to talk to John about the details of his trip. Bill and Mary are having a conversation with Sue about their mutual friend John, unaware of the fact that Sue was involved in the planning of the trip.*

(18) a. Bill: (I guess that) John went to Colombia and Brazil (because he was always fascinated by Amazonia).
b. (Mary: He couldn't have missed Peru and the Machu Picchu!)

(19) Sue: He didn't*H** visit Colombia and*L+H** Brazil*L-L%*

As (18) illustrates, a conjunction comprising the same conjuncts (*Colombia*, *Brazil*) has to be made contextually salient as a prerequisite for the rise-fall-rise contour in the sentence with contrastive negation (19). This is achieved with the turn in (18a). In addition, there can be further evocation of possibilities, like (18b), but need not.

2.1.2. Example of an infelicitous discourse

The overall scenario is the same as in the preceding section (2.1.1).

(20) a. Mary: (I guess that) John visited Colombia (I know he loved watching Narcos).
b. Bill: He (certainly) went to Brazil (he had always been fascinated by Amazonia).
c. (Mary: He couldn't have missed Peru and the Machu Picchu..!)

(21) Sue: # He didn't*H** visit Colombia and*L+H** Brazil*L-L%*

Mere invocation of the individual conjuncts does not create the right context for negated conjunction with stress on *and*, since presence of the left conjunct (*Colombia* in (20a)), followed by the right conjunct in the next conversational turn (*Brazil* in (20b)) did not make (21) felicitous. The outcome would be the same for a context from which the two conjuncts are entirely absent, i.e. not made salient at all. We thus see that the prosodic pattern must be licensed in the discourse, since the stressed connective seems to be dependent on another conjunction present in the context.

2.2. Stress and scalar alternatives

The rising pitch accent on the connective represents contrastive focus on conjunction in the scope of negation. As such, it is naturally followed by a *but*-phrase (22), and in fact it requires a continuation, the choice ranging among those discussed in section 1.1.

(22) He didn't*H** visit Colombia and*L+H** Brazil*L-L%*... but only one of the two.

In more formal terms, what the presence of the stress on the connective does is that it triggers the scalar alternative with disjunction *or*, obtained by replacing *and* with its scalemate. As discussed in section 1.2, the scalar alternative (23b) is logically stronger than the assertion (23a), as the former entails the latter (23c). A scalar implicature thus arises when the stronger alternative is negated (23d), and added to the assertion (23e). A standard, (neo-)Gricean approach (Grice, 1989; Krifka, 1995) could capture this, via a purely pragmatic mechanism (Szabolcsi and Haddican, 2004).

(23) a. Assertion: $\neg(C \wedge B)$
b. Scalar Alternative: $\neg(C \vee B)$
c. $\neg(C \vee B) \Rightarrow \neg(C \wedge B)$
d. Scalar Implicature: $\neg(\neg(C \vee B))$
e. $\rightsquigarrow$ He visited either Colombia or Brazil.

This is an instance of a so-called indirect implicature (Chierchia, 2004), where a strong scalar element eventually gives rise to a weak meaning (23e) in the scope of a DE operator. Implicatures are known to be defeasible, however, this inference cannot be canceled, as the unavailability of the continuations in (24) signals.

(24) He didn't visit Colombia and*F* Brazil
a. # ... Actually, he visited neither country.
b. # ... In fact, he only went to Peru, in the end.

The two follow-up assertions (24) would correspond to the basic inference of the sentence, i.e. the assertion (23a) without the scalar implicature (23d), thus compatible with a 'neither' interpretation. Crucially, both are infelicitous. On the other hand, ignorance inferences may, but need not be attested, as illustrated in (25).

(25) He didn't visit Colombia and*F* Brazil
a. ... He visited (only/just) Colombia. / ... He visited (only/just) Brazil.
b. ... He visited either Colombia or Brazil, but I don't know which one he chose.

The continuations in (25a) show that ignorance inferences by which 'the speaker doesn't know/ believe that John didn't visit Colombia' and 'the speaker doesn't know/ believe that John didn't visit Brazil' need not arise, whereas the follow-up in (25b) shows that (25) is not incompatible with them.

2.3. Obligatory exhaustification

Indefeasibility of the scalar implicature points to obligatory exhaustification. In other words, some mechanism must ensure that the scalar alternative always gets negated. Moreover, the implicature is preserved even inside DE environments, such as the restrictor of the universal quantifier in (27).

Scenario: *Students doing the Latin American History curriculum must travel to some countries in the region, at their choice.*

(26) Mary: I guess that most students tried to go to Colombia and Brazil (because these are neighboring countries, but with different colonial background)...

(27) Sue: Well, everyone who didn't visit Colombia and*F* Brazil...

(28) a. Sue: ... visited (just/only) Colombia. / ... visited (just/only) Brazil.
  b. Sue: # ... went only to Peru.

Infelicity of continuations compatible with 'neither' interpretations in matrix contexts, as well as in embedded ones, means that the presence of the scalar implicature must be provided by a grammatical device which can be applied locally, if need be. The mechanism is thus the following: focus on the connective activates the scalar alternatives with disjunction (Krifka, 2007; Fox and Katzir, 2011). Once active, alternatives must be exhaustified. A silent operator EXH is inserted for this purpose (Fox, 2007; Chierchia, 2013). EXH_{IE} negates all alternatives which are members of the set of innocently excludable alternatives ALT_{IE} (29). Such alternatives must meet two conditions (30): to not be entailed by the assertion and to not have their negation, when added to the assertion, entail another alternative from the set, as shown in (31).

(29) $[\![\text{EXH}_{IE}\ \phi]\!] = \phi \wedge \forall\psi \in \text{ALT}_{IE}(\phi): \neg\psi$ (Meyer, 2015: 494)

(30) $\psi \in \text{ALT}_{IE}(\phi)$ iff $\psi \in \text{ALT}(\phi)$ & $\neg(\phi \Rightarrow \psi)$ & $\neg\exists\chi \in \text{ALT}(\phi)$ & $\phi \wedge (\neg\psi) \Rightarrow \chi$ (idem)

(31) a. $\neg(\text{C}\wedge\text{B}) \wedge \neg\neg\text{C} \Rightarrow \neg\text{B}$
  b. $\neg(\text{C}\wedge\text{B}) \wedge \neg\neg\text{B} \Rightarrow \neg\text{C}$

By (30, 31), neither of the two subdomain alternatives of negated conjunction ($\neg$C; $\neg$B) would make it into ALT_{IE}, since negating $\neg$C together with the assertion entails $\neg$B (31a), and the same goes for $\neg$B (31b). This means that, even if subdomain alternatives were active, they would not be added to the computation. Now, one application of EXH_{IE} disambiguates in favor of a logically weaker reading (32), since 'either C or B' is weaker than 'neither C nor B'.

(32) $\text{EXH}_{IE}\ (\neg(\text{C}\wedge\text{B})) = \neg(\text{C}\wedge\text{B}) \wedge \neg(\neg(\text{C}\vee\text{B})) = (\text{C} \vee \text{B}) \wedge \neg(\text{C}\wedge\text{B})$

(33) He visited Colombia or Brazil, but not both.

The resulting interpretation with the obligatory indirect implicature thus corresponds to a reading that could be expressed by an unembedded exclusive disjunction (33).[6] This is in full compliance with the (un)availability of different continuations, shown in sections 2.1.1 and 2.1.2, as well as (24, 25).

[6]For negated stressed *or*, see Meyer (2015); Fox and Spector (2018).

To summarize, the combination of a contextually salient conjunction and negation with focus on the connective inevitably activates the scalar alternative with disjunction. No other alternatives are activated, i.e. individual conjuncts do not enter the computation as subdomain alternatives. EXH operator is inserted at the root of the clause, yielding the ‘not both’ interpretation.

3. Stress on the whole conjunction

As shown in (34), the intonation contour of a pattern with negated unstressed *and* comprises the primary high pitch accent on negation and a secondary one on the conjunction, more precisely, it marks the second member of the coordination.

(34) He didn’t*H** visit [Colombia and Brazil]*H*-L%* $[\neg C] \wedge [\neg B] \Leftrightarrow \neg [C \vee B]$

The ‘neither’ reading that (34) gets can correspond either to a conjunction scoping over negation or to a disjunction in the scope of negation (due to one of de Morgan’s equivalences). This version of negated conjunction is often considered to be marginal or even unacceptable in English (Szabolcsi and Haddican, 2004). This might seem so when the pattern is taken in isolation, without an appropriate context. However, with the right contextual embedding, the ‘neither’ reading is available for negated definite conjunction, just like the ‘not both’ reading has been shown to be available only following an occurrence of a positive conjunction in the preceding discourse. In other words, neither of the patterns is available freely. Now, the presence of focus activates alternatives, as before. The difference is that this time no scalar alternative is activated, since there is no focus on the connective *and*. But individual conjuncts must be contextually salient, which facilitates retrieval of subdomain alternatives from the coordinative structure (Sauerland, 2004; Katzir, 2007; Fox and Katzir, 2011; Singh et al., 2016).

3.1. Preceding context

As already pointed out, a negated conjunction requires specific contextual conditions to be felicitously uttered. When no stress is placed on *and*, but the second conjunct bears high pitch accent, the preceding discourse ought to take a different form than the one of negated conjunction with a stressed connective.

3.1.1. Example of a felicitous discourse

(35) a. Bill: (I guess that) John went to Brazil (because he has always been fascinated by Amazonia).
b. Mary: He (certainly) visited Colombia (because I know he loved watching Narcos).
c. (Bill: He couldn’t have missed Peru and the Machu Picchu..!)

(36) Sue: He didn’t*H** visit [Colombia and Brazil]*H*-L%*

(37) a. ... But he did go to Peru.
b. ... He visited Argentina instead.

This time, individual conjuncts need to be made salient in the preceding context. This is achieved with the two conversational turns in (35a) and (35b). A third alternative can be invoked, as in (35c). The negated conjunction with no stress on the connective (36) is now licensed. Since the sentence in (36) receives a 'neither' interpretation, the allowed continuations are the opposite of the ones with negated conjunction with a stressed connective. An utterance with a third, previously invoked (37a) or not (37b) alternative, one that does not correspond to either of the conjuncts is a felicitous follow-up.

3.1.2. Example of an infelicitous discourse

(38) a. Bill: (I guess that) John went to Argentina (because he adores tango).
b. Mary: He couldn't have missed Peru and the Machu Picchu!
c. Bill: (It is also possible that) he visited Chile, to see the Atacama desert...

(39) Sue: # He didn't*H** visit [Colombia and Brazil]*H**

If there is no previous mention of *Colombia* and of *Brazil*, the sentence in (39) cannot be felicitously uttered under the indicated prosody, since two names make up the conjuncts in (39). This is shown with the preceding context as in (38), where neither of the speakers invoked either of the countries. As shown before, only the continations compatible with a 'neither' reading are felicitous. I now go on to reveal the cause.

3.2. No wide scope conjunction

One might suggest that this strong, 'neither' reading arises as a result of a different LF – one where the conjunction scopes over negation. This way, the 'not both' reading with the stressed connective would correspond to the surface scope interpretation ($\neg$[C$\wedge$B]), whereas the 'neither' reading would correspond to the inverse scope interpretation ([$\neg$C]$\wedge$[$\neg$B]). However, an inverse scope LF is not plausible because a sentence with an existential quantifier cannot receive an interpretation in which different people didn't visit Colombia and Brazil (40).

(40) Somebody didn't visit Colombia and Brazil.
$\neq$ Somebody didn't visit Colombia and somebody didn't visit Brazil.

If the conjunction could outscope the negation, then an explanation would have to be found for the availability of binding from a subject negative quantifier into one of the conjuncts (41).

(41) No mother$_i$ praised her$_i$ child and the teacher.

Moreover, the additive focus particle *either*, which appears in negative environments and requires a negative antecedent, cannot be attached only to the second conjunct (42a) with the same meaning as the clausal conjunction in (42b), where the presence of *either* is required.

(42) a. # He didn't visit Colombia and Brazil either.
b. He didn't visit Colombia and he didn't visit Brazil ?*(either).

Empirical evidence thus suggests that the wide scope conjunction is not what yields the 'neither' reading. We have already seen that the 'not both' reading is also not easily maintained with a simple narrow scope conjunction, since an extra mechanism is needed to derive its obligatory implicature. In fact, the same mechanism can be employed to derive the 'neither' reading. This time, nevertheless, the set of alternatives contains only individual conjuncts, as reflected already in the shape of the preceding context.

3.3. Subdomain alternatives and recursive exhaustification

Sections (3.1.1) and (3.1.2) illustrate the requirement of negated conjunction with an unstressed connective for appropriate antecedents. Namely, members of the coordination have to be contextually salient for a sentence with focus marked on the second member of the conjunction under negation to be acceptable. Crucially, this enables activation of so-called subdomain alternatives ¬C and ¬B to the assertion with negated conjunction. Since the connective *and* is this time not marked by focus, the scalar alternative with the disjunction is not activated. The conjuncts *Colombia*, *Brazil* are not each F-marked either, but their contextual salience, as well as the fact that they can be retrieved from the assertion itself, allows them to enter the implicature computation. Crucially, the formation of subdomain alternatives does not rely on accessing the lexicon (unlike with scales). Again, once active, alternatives have to be exhaustified. Although neither of the subdomain alternatives is entailed by the assertion (43), they do not make part of the set of innocently excludable alternatives ALT_{IE}, since negation of either of them in conjunction with the assertion would entail the other alternative, as demonstrated in section 2.3. This makes one application of EXH_{IE} vacuous (44).

(43) a. $\neg(\text{C}\wedge\text{B}) \not\Rightarrow \neg\text{C}$
b. $\neg(\text{C}\wedge\text{B}) \not\Rightarrow \neg\text{B}$

(44) $\text{EXH}_{IE}\ \neg(\text{C}\wedge\text{B}) = \neg(\text{C}\wedge\text{B})$

Such a result is unsatisfactory, since the presence of focus marking on the whole conjunction does not lead to any meaning enrichment whatsoever. But EXH_{IE} can be applied recursively. The input for iterated exhaustification is the set $\text{ALT}_{EXH_{IE}}$ (45) containing an already exhaustified assertion, but also subdomain alterantives which have undergone one round of exhaustification (46).

(45) $\text{ALT}_{EXH_{IE}} = \{\neg(\text{C}\wedge\text{B}), \neg\text{C}\wedge\neg(\neg\text{B}), \neg\text{B}\wedge\neg(\neg\text{C})\}$

What makes up the set in (45)? The exhaustification of the assertion is vacuous (46a), as already shown. But this is not the case with subdomain alternatives: they are logically independent of each other, so the first application of EXH does have an effect, as shown in (46b) and (46c).

(46) 1st round of exhaustification
a. Assertion: $\text{EXH}_{IE}\ (\neg(\text{C}\wedge\text{B})) = \neg(\text{C}\wedge\text{B})$
b. Subdomain alternative 1: $\text{EXH}_{IE}\ (\neg\text{C}) = \neg\text{C} \wedge \neg(\neg\text{B})$
c. Subdomain alternative 2: $\text{EXH}_{IE}\ (\neg\text{B}) = \neg\text{B} \wedge \neg(\neg\text{C})$

We now have the input (45) for the second application of EXH_{IE} (47). The two rounds of exhaustification yield a stengthened, 'neither'-like reading (47d). This is due to the fact that exhaustified subdomain alternatives are stronger than the exhaustified assertion, so they get negated in the step in (47b). Logical equivalences allow the transformation of (47b) to (47c), and the latter is equivalent to a negated disjunction (47d).

(47) 2nd round of exhaustification
   a. $\text{EXH}_{IE}(\text{EXH}_{IE}\ \neg(\text{C}\wedge\text{B})) = \text{EXH}_{IE}\ (\neg(\text{C}\wedge\text{B})) \wedge \neg(\text{EXH}_{IE}\neg\text{C}) \wedge \neg(\text{EXH}_{IE}\neg\text{B}) =$
   b. $= \neg(\text{C}\wedge\text{B}) \wedge \neg(\neg\text{C} \wedge \neg(\neg\text{B})) \wedge \neg(\neg\text{B} \wedge \neg(\neg\text{C})) =$
   c. $= \neg(\text{C}\wedge\text{B}) \wedge (\neg\text{C} \rightarrow \neg\text{B}) \wedge (\neg\text{B} \rightarrow \neg\text{C}) =$
   d. $= \neg(\text{C}\vee\text{B})$

Thus obtained strengthened meaning is equivalent to a conjunction of two negative statements, 'He didn't visit Colombia and he didn't visit Brazil'. This means that the Homogeneity inference with negated conjunction comes about through the activation of alternatives and implicature computation, and not as a special presupposition. For this reason, the question in (48) is a felicitous follow up – namely, such locutions target implicatures computed in the grammar (Meyer, 2013).

(48) Sue: He didn't visit [Colombia and Brazil]*F* $\neg\text{C}\wedge\neg\text{B} \Leftrightarrow \neg(\text{C}\vee\text{B})$
   Mary: Are you saying that he visited neither?

Crucial ingredients of this proposal for deriving the strong reading of negated conjunction therefore are pre-exhaustified subdomain alternatives, in contrast to the pattern with focused *and*.

3.4. Summary

An exhaustification mechanism is needed to derive the readings of both of the prosodic patterns which constitute the minimal pair discussed in this paper. Presence of focus, on the connective or at the end of the conjunctive phrase, as well as contextual salience, activate different sets of alternatives. The difference between the two patterns then lies in the form of alternatives that are activated and the number of applications of the silent exhaustifying operator EXH.

Let us now show how this proposal draws and how it differs from the existing accounts of negated conjunction.

4. Definite conjunction in the literature

This section situates the current proposal for negated unstressed *and* in the context of research on definite conjunction, its relation to definite plurals, the behavior under negation, and two relevant approaches to these phenomena (Magri, 2014; Szabolcsi and Haddican, 2004).

4.1. Pluralities and Homogeneity

The behavior of negated definite conjunction with unstressed *and* was attributed to the Homogeneity inference. But the same effects have been observed for plural definites, which motivated a unified analysis (Hoeksema, 1983, 1988; Winter, 2001). Namely, definite conjunction (49a) and plural definites (49b) both receive a universal/conjunction-like (49c) interpretation in positive contexts (49), but not in the scope of DE operators (50), where they display behavior of their weak scalemates and yield strong readings (50a, 50b), unlike the universals (50c).

(49) a. He visited Colombia and Brazil. $\wedge$
b. He visited the countries. $\forall$
c. He visited both/each of the countries. $\forall$

(50) a. He didin't visit Colombia and Brazil. $\neg > \vee$
b. He didn't visit the countries. $\neg > \exists$
c. He didn't visit both/each of the countries. $\neg > \forall$; $* \neg > \exists$

Homogeneity is usually modeled as a presupposition, exemplified in (51). [7]

(51) He visited Colombia and Brazil.
a. 1 iff he visited both countries,
b. 0 iff he visited neither country,
c. # iff he visited one but not the other.

Crucially, it is possible to derive this inference using alternatives and exhaustification, which is what Magri (2014) proposes for plural definites, building on Spector (2007), as well as for definite conjunctions. The two implementations are different in that plural definites are assumed to have an existential-like basic semantics, which requires strengthening in UE contexts into a universal, whereas the take on unfocused *and* proceeds the opposite way. Namely, in an UE environment conjunction is already the strongest element, whence the parallelism with universals (49). However, in the scope of negation, a conjunction of definites needs to be strengthened from the 'not both' to the 'neither' reading. This is achieved via double exhaustification. Magri assumes that sentences with focused and the ones with unfocused *and* under negation are scalar alternatives to each other, although there is a mutual entailment (52a). On the other hand, only focused *and* has the disjunction *or* as a scalar alternative (52b), according to him.

(52) a. $\text{and}_F \Leftrightarrow \text{and}_{unF}$
b. $\text{and}_F \Rightarrow \text{or}$

Magri derives Homogeneity of unstressed *and* in the scope of DE operators using only the alternatives defined in (52) and double exhaustification. For (50a) this roughly looks like (53).

(53) $\text{EXH}\ (\text{EXH}\ (\neg(\text{C}\mathit{and}_{unF}\text{B}))) = (\text{EXH}(\neg(\text{C}\mathit{and}_{unF}\text{B})) \wedge \neg(\text{EXH}(\neg(\text{C}\mathit{and}_F\text{B}))$
$= \neg(\text{C}\wedge\text{B}) \wedge \neg(\neg(\text{C}\wedge\text{B}) \wedge \neg(\neg\text{C}\vee\text{B})) = \neg(\text{C}\vee\text{B})$

[7] Homogeneity presupposition in Beck (2001) for distributive one-place predicates $*P$ and pluralities A:

(1) a. $*\text{P}(\text{A}) = 1$ iff $\forall x[x \in \text{A} \rightarrow \text{P}(x)]$
b. $*\text{P}(\text{A}) = 0$ iff $\forall x[x \in \text{A} \rightarrow \neg\text{P}(x)]$
c. undefined otherwise

However, when unstressed *and* is inside non-monotonic environments, such as the scope of *exactly NP*, the Homogeneity inference disappears in the DE component of the non-monotonic meaning, given that the sentence is compatible with some of the other students visiting one or the other country (54). To remedy this, Magri introduces subdomain alternatives in the computation for unfocused *and* (54a), which eventually derives the attested interpretation (54c).

(54) Exactly one student visited Colombia and_{unF} Brazil...
And two other students visited only one of them.
a. EXH $(\exists![\text{C}\,\textit{and}_{unF}\text{B}]) = \exists![\text{C}\wedge\text{B}] \wedge \neg\exists!\text{C} \wedge \neg\exists!\text{B}$
b. $= (\exists 1[\text{C}\wedge\text{B}] \wedge \neg\exists 2[\text{C}\wedge\text{B}]) \wedge \neg(\exists 1\text{C} \wedge \neg\exists 2\text{C}) \wedge \neg(\exists 1\text{B} \wedge \neg\exists 2\text{B})$
c. $= (\exists 1[\text{C}\wedge\text{B}] \wedge \neg\exists 2[\text{C}\wedge\text{B}]) \wedge \exists 2\text{C} \wedge \exists 2\text{B}$

Notice that only subdomain alternatives are present in (54a) because the alternative with focused *and* ($\exists![\text{Cand}_F\text{B}]$) cannot be excluded, since it has the same meaning as the prejacent ($\exists![\text{Cand}_{unF}\text{B}]$). Crucially, the inclusion of subdomain alternatives would not affect the derivation for unstressed *and* in DE environments (55), as acknoweledged by Magri.

(55) a. $\text{EXH}(\text{EXH}(\neg(\text{C}\,\textit{and}_{unF}\text{B}))) =$
b. $= \text{EXH}(\neg(\text{C}\,\textit{and}_{unF}\text{B}) \wedge \neg(\text{EXH}(\neg(\text{C}\,\textit{and}_F\text{B})) \wedge \neg\text{EXH}(\neg\text{C}) \wedge \neg\text{EXH}(\neg\text{B})$
c. $= \neg(\text{C}\wedge\text{B}) \wedge \neg(\neg(\text{C}\wedge\text{B}) \wedge \neg(\neg\text{C}\vee\text{B})) \wedge \neg(\neg\text{C} \wedge \neg\neg(\text{C}\vee\text{B})) \wedge \neg(\neg\text{B} \wedge \neg\neg(\text{C}\vee\text{B}))$
d. $= \neg(\text{C}\vee\text{B})$

But there is no need to entertain the set of 'scalar' alternatives by assuming that negated conjunctions with focused (and_F) and with unfocused *and* (and_{unF}) are alternatives to each other, if subdomain alternatives are sufficient to derive the right meaning. The absence of the alternative with focused *and* from the computation for unfocused *and* in non-monotonic environments (54a) gave a satisfactory result (54c) on Magri's account. Moreover, it was already shown in section 3.3 that the computation for unfocused *and* in DE contexts yields the right result with subdomain alternatives only. Thus, the proposal layed out in this paper builds on Magri's account and modifies it, capitalizing on the distinction between scalar and subdomain alternatives. I assume that focus on the connective *and* activates alternatives which consist of its scalemate *or*. However, when *and* is not focused, alternatives are formed out of constituents of the conjunctive structure. This creates the split between the two prosodic patterns – one uses only scalar alternatives in the implicature computation, whereas the other uses only subdomain. This is compatible with different requirements for contextual salience: when the connective is not stressed under negation, only individual conjuncts, ideally along with some other alternatives, should be contextually salient; when the connective is stressed, an identical conjunction without negation should be present in the preceding context. Just like Magri's, the present proposal derives Homogeneity entirely through implicature computation, and without stipulating a presupposition. Unlike Magri's account, no radical assumptions are made about what can enter the set of alternatives available to EXH – since the 'real' scalar alternative with *or* is not part the alternative set for unfocused *and* anyway, 'lexical' replacement with focused *and* should not be allowed, either.

4.2. ‘Expected both’

Szabolcsi and Haddican (2004) draw attention to the competition between negated unstressed *and* (56), negated unstressed *or* (57) and *neither...nor* (58).

(56) He didn’t visit Colombia *and* Brazil.

(57) He didn’t visit Colombia *or* Brazil.

(58) He visited neither Colombia *nor* Brazil.

The three sentences have the same truth-conditions, namely, they read ‘neither’ instead of ‘not both’. According to Szabolcsi and Haddican (2004), the difference is that (56) in addition carries an expectation that the subject would visit both Colombia and Brazil. In (58) Colombia and Brazil are discourse salient and under discussion, but no expectation is present, according to them. (57) is the most neutral version, as it does not display any of these effects. They further observe that the ‘neither’ reading is more readily available for stereotypical pairs (59a), although it is possible to create a context in which seemingly unrelated conjuncts (59b) are expected to hold, making the unstressed *and* with its ‘neither’ reading acceptable.

(59) a. Mary didn’t take math and physics.
b. Mary didn’t take hockey and algebra.

It is unclear what produces this ‘expectation’ and Szabolcsi and Haddican (2004) explored different possibilities as the potential source of such a requirement: the Homogeneity presupposition, negation itself, and the competition between connectives (56–58). However, it turns out that there need not be any real expectation that an alternative should hold – it suffices that the conjuncts are invoked in the preceding context, as shown in section 3.1.1. Now, one might say that a speaker would not bring up something in a conversation, if there is no expectation regarding it. In other words, it is hard to ‘get rid’ of the ‘expectation’ effect whenever an alternative is explicitly made salient... Unless it is overtly negated. Interestingly, this does not preclude a sentence with a negated unstressed *and* (61), as shown with the preceding context in (60).

(60) a. Bill: (I guess that) John went to Brazil (because he is learning Portuguese).
b. Mary: He (certainly) didn’t visit Colombia (because he hates Shakira).
c. (Bill: But I’m sure he didn’t miss Peru and the Machu Picchu!)

(61) Sue: He didn’t*H** visit [Colombia and Brazil]*H*-L%*

This shows that the two conjuncts need not be ‘expected’ to render the predicate true, it suffices that they are made contextually salient. However the ‘expectation’ requirement might seem, it likely results from one step in the second application of EXH (62) which comprises a biconditional: if he did not visit Colombia then he did not visit Brazil and vice versa.

(62) ... = $\neg(C \wedge B) \wedge (\neg C \rightarrow \neg B) \wedge (\neg B \rightarrow \neg C)$ = ...

The 'expected both' effect thus seems to be a mere by-product of an independently needed implicature computation. In fact, the same mechanism which is responsible for the Homogeneity inference is also responsible for the 'expectation' and for the fact that it only shows up in DE contexts. The present proposal reverses the cause and the consequence: it is not the 'expectation' that somehow licenses the 'neither' reading in English, but the other way around. Crucially, it is not modeled as a special presupposition. Finally, the absence of 'expected both' with negated unstressed *or* is due to the absence of exhaustification. Nevertheless, the current proposal draws on similarities between negated unstressed *and* and *neither...nor*. Showing how exactly these two constructions are related is left for some other occasion.

5. Conclusions and further issues

5.1. Make up of alternative sets

As emphasized in the previous section, the two readings of negated definite conjunction result from two different alternative sets and from simple or recursive exhaustification (63).

		ALT	EXH
(63)	not...and$_F$	$\neg$(C$\vee$B)	1$\times$
	not...and$_{unF}$	$\neg$C, $\neg$B	2$\times$

In the case of focused *and*, the presence of high pitch accent on the connective activates the lexical substitution mechanism by which *and* gets replaced with its scalemate *or*. This generates the so-called scalar alternative ($\neg$(C$\vee$B)), in line with the usual approaches to focus and implicature. The activation of individual conjuncts as alternatives is undetectable in this case, since they would not enter the set of innocently excludable alternatives anyway. Nevertheless, the absence of stress on the conjuncts, as well as the presence of the non-negated version of the same conjunction in the preceding discourse make it imaginable that the subdomain alternatives are left idle in this pattern.

As for the pattern with unfocused *and*, the connective does not bear high pitch accent and it is often phonologically reduced (*'nd*). This is one of the reasons why the lexical substitution mechanism for generating alternatives is deactivated this time. Crucially, generating subdomain alternatives means retrieving the individual conjuncts from the structure and does not require access to the lexicon, unlike activating $\neg$(C$\vee$B). Moreover, they represent terminal nodes in a focus-marked constituent ([Colombia and Brazil]$_F$), and they have been explicitely mentioned in the context (Katzir, 2007; Fox and Katzir, 2011). Singh et al. (2016) argue that matrix disjunctive sentences in the adult grammar of English get strengthened in strikingly different ways depending on whether the set of alternatives is closed under conjunction – when it is, simple exhaustification renders the scalar implicature ('not both'), but when it is not, recursive exhaustification produces conjunctive readings (Free Choice). Furthermore, it is claimed that contextual pruning of alternatives, by which certain alternatives from the formal set can be eliminated, is not available because it can only apply to a subset of relevant alternatives, and relevance is closed under conjunction. The case of negated unstressed conjunction is parallel, since relevance of subdomain alternatives ($\neg$C, $\neg$B) entails the relevance of the scalar alternative $\neg$(C$\vee$B), due to the presence of negation and de Morgan's equivalence ($\neg$(C$\vee$B) $\Leftrightarrow$ $\neg$C$\wedge$$\neg$B) which provides the closure under conjunction. However, if the conjunctive alternative is not in the set of formal alternatives, relevance and closure under conjunction do not matter.

5.2. Stress placement and quality

This proposal refers only to stress placement as a factor in the generation of alternatives, and leaves stress quality out of the equation, which raises questions. Namely, the fall-rise contour on *and* remains unexploited, although there are accounts that go in the direction of attributing a more compositional status to it (Meyer, 2015). Moreover, it is unclear why L-H* on *and* is required for activating the scalar alternative in this case, and under which circumstances a simple H* on *and* would be fit for the job.

Similarly, is the focus, i.e. high pitch accent on the whole conjunction really necessary in the other pattern? Or could it be an instance of second occurrence focus, realized by stress, but without a high pitch accent (Büring, 2016)? It is also reminiscent of Focus-projection rules, which could go either way here, given that they concern heads and their arguments. Crucially, the presence of focus on the whole conjunction could be an instance of broad focus, which does not necessarily prevent activation of scalar alternatives (Fox and Spector, 2018). Alternatively, a default prominence approach could be invoked (Arregi, 2016).

One important point that has been neglected throughout this paper is that the negation bears stress in both of the examined patterns. But the stress on negation turns out to be vital because, when it is removed from the pattern with the fall-rise on *and*, the whole sentence yields the 'neither' reading!

(64) He didn't visit Colombia and*L+H** Brazil*L-H%* 'neither'

This shows that the obligatory scalar implicature that underlies the 'not both' reading of negated conjunction is dependent on the presence of stress on negation. In fact, Chierchia (2004) observed this as an indirect implicature, but without discussing the prosody. Szabolcsi and Haddican (2004) also reported about the scalar implicature and attributed it to the presence of stress on *and*. What this paper adds is that (i) the focus on the connective should be realized as the fall-rise contour, and (ii) that the negation also needs to be stressed. The latter is actually unsurprising in light of the fact that the conjunction was already given in the context, so the new information (negation) is F-marked (Schwarzschild, 1999). What has also gone unnoticed is that the pattern with unstressed *and* and the 'neither' reading require stress on negation in addition, otherwise degradedness ensues. Again, this reflects the need for contextual antecedents, identified as the 'expectation': negation is F-marked as new information, and what follows is given. Due to this, both patterns fall under the notion of contrastive negation.

5.3. The Symmetry Problem

In the pattern with unstressed *and*, where subdomain alternatives are active, if ¬B is present in the computation, then B should be, as well: it is no more complex than ¬B, it can be structurally derived, and it was contextually salient (Fox and Katzir, 2011). The same goes for ¬C and C. Moreover, the set of relevant alternatives should contain symmetric alternatives of the kind, as relevance is closed under negation. But this would prevent EXH from giving any palpable result. The standard view on symmetry is that it can be broken only formally, and not in the context. Thus for some reason, stress on negation seems to have an effect on two problematic symmetries: the one involving conjunction and the one involving negation.

5.4. Trigger for (double) exhaustification

Exhaustification by a silent operator inserted in the syntax is sometimes considered a controversial mechanism, and recursive exhaustification more often so. For negated focused *and*, the '*Only* Implicature Generalization' Fox (2007) could be invoked, by which the insertion of EXH mimics the association of an overt focus particle (*only*) to an F-marked constituent. The high pitch accent on the connective thus licenses the insertion of the EXH operator.

In the case of unstressed *and*, the situation is trickier because not one, but two rounds of exhaustification need to be justified. F-marking on the whole conjunction triggers exhaustification which is, unless iterated, without effect. Fox and Spector (2018) Economy Condition precludes incremental weakening of the meaning, which eventually yields global weakening: 'an occurrence of EXH is globally weakening in a sentence S if eliminating it does not alter or strengthen truth conditions, i.e. if S(A) entails S(EXH(A))'. In our case, double exhaustification prevents global weakening of the meaning. Recursive exhaustification thus allows to produce an actual contribution to the meaning and eventually avoid semantic vacuity of both a whole prosodic pattern and an operation that comes with it. Moreover, it seems to be a more general tendency that activation of subdomain alternatives and their membership in the ALT_{IE} goes hand in hand with recursive exhaustification (the only exception that comes to mind are Negative Polarity Items, as in Chierchia (2013)).

Finally, Fox (2007) lays out a functional motivation for exhaustification: an EXH operator is inserted in order to eliminate unwanted ignorance inferences otherwise derived by Gricean reasoning. In other words, it strengthens the meaning. As shown in the accounts of the two patterns studied here, ignorance inferences can be eliminated, and the purpose of EXH is fulfilled. Similarly, Singh et al. (2016) do not assume that such an exhaustification mechanism is present by default, but that a preference for a parse with EXH exists in order to provide a complete answer to the Question Under Discussion, which seems like a plausible incentive in both of our patterns with negated conjunction.

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Final appositives at the right frontier: An experimental investigation of anaphoric potential[1]

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Abstract. This paper presents two experiments testing two—not mutually exclusive—accounts of the special status of final appositive relative clauses (Syrett and Koev, 2015; Anderbois et al., 2010/2015). The speech act account (Frazier et al., 2017) argues that appositives—in contrast to restrictive relative clauses—contribute a quasi-independent speech act and are available for discourse continuations by virtue of constituting the most recent speech act when in final position. The discourse structure account (Jasinskaja, 2016; Hunter and Asher, 2016) frames the problem in terms of Segmented Discourse Representation Theory (Asher and Lascarides, 2003), arguing that only sentence-final clauses make discourse segments at the right edge of the discourse structure available and more so with coordinating relations such as NARRATION. The experiments manipulated the type of relative clause and the type of discourse relation holding between the matrix clause and the final relative clause to test the distinct predictions of these accounts. Both relative clause type and discourse relations affected the interpretation of ambiguous pronouns, providing support for both accounts. The experiments also explored differences between personal and propositional pronouns but found no conclusive evidence for an interaction of anaphora type with the other factors.

Keywords: anaphora, at-issueness, relative clauses, discourse structure.

1. Introduction

Appositive relative clauses (ARCs), as the one underlined in (1), have received attention in the semantics literature in particular as a prime example of *not at-issue content* (Potts, 2005): While the main clause content in (1) can be targeted by direct denial (1a), targeting the ARC results in infelicity (1b). However, as already noted by Potts (2005) and elaborated on by Anderbois et al. (2010/15), the outcome of the deniability test depends on the position of the ARC in the sentence. As (2) shows, the infelicity of directly denying the ARC disappears if it occurs sentence-finally. This positional effect has furthermore been supported in two experiments by Syrett and Koev (2015), which will be discussed in more detail in section 2. This current paper picks up where Syrett and Koev left off by taking the positional effect for granted and providing an experimental investigation of the accounts that might explain the special status of final ARCs, namely the speech act account of Frazier et al. (2017) and the discourse structure account of Jasinskaja (2016) and Hunter and Asher (2016).

(1) A: Emma, who has two cats, cleaned the litter boxes.
   a. B_{MC}: No, she didn't.
   b. B_{RC}: #No, she doesn't.

(2) A: Tiffany took stats with Burns, who is a happy soul.
   a. B_{MC}: No, she didn't.
   b. B_{RC}: No, he isn't.

[1]Many thanks to Rajesh Bhatt, Chuck Clifton, Brian Dillon, Lyn Frazier, Julie Hunter and Kristen Syrett, as well as audiences at CUNY 31 in Davis, the 2nd International Conference on Prominence in Language in Cologne, and Sinn und Bedeutung 23 in Barcelona. All faults of and in this paper remain my own.

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While the debate around the positional effect is framed as concerning the at-issueness status of ARCs—given that the deniability test is assumed to detect just that—there is reason to keep these notions—at-issueness and deniability—distinct from each other, as Snider (2017) notes. At-issueness, being a theoretical notion, has been defined by Simons et al. (2010) in terms of relevance of a speaker's intention to the Question Under Discussion (QUD) (see the paper for a formal statement of the definition). However, Snider observes that two of the main diagnostics for at-issueness proposed by Tonhauser (2012)—(non-)deniability and the ability to address a QUD—differ with respect to their sensitivity to the position of an ARC. While ARCs can be directly denied if in final position, as illustrated in (1)-(2) above, addressing a QUD with an ARC is infelicitous irrespective of its syntactic position, as shown in (3) (but see Esipova, 2018). In light of this difference, Snider argues that what the deniability test detects is not at-issueness but rather the availability of a proposition for anaphoric reference—its *anaphoric potential*. This reasoning is based on the assumption that response particles like *yes* and *no* can be treated as propositional anaphors (e.g. Krifka, 2013). On this view, the unacceptability of (1b) can then be seen as resulting from the inability or difficulty to find a suitable referent.

(3) Who is Margaret's cousin?
   a. #Pauline, who is Margaret's cousin, was interviewed by Food Network.
   b. #Food Network interviewed Pauline, who is Margaret's cousin.

With respect to how ARCs have been featured in the debate on at-issueness, it is also worth noting that restrictive relative clauses (RRCs) have been largely ignored, despite RRCs being standardly analyzed as being presupposed and thus not at-issue according to Potts (2005), alike to the conventional implicature contributed by ARCs. While not at-issue *content* has to be distinguished from not at-issue *status*, the latter depending on the relation between the contributed content and the QUD as described above, RRCs do behave similarly to ARCs in that the applicability of the deniability test is sensitive to their position in the sentences (4)-(5). However, intuitively, targeting an RRC with direct denial still seems easier than targeting an ARC. Viewing this difference in terms of their relative anaphoric potential, as modulated by other differences between the two clause types, rather than their at-issueness status might be more promising, given that we want to maintain a close correspondence between at-issue content and status.

(4) [Context: There are two linguists cleaning up after a party.]
   A: The linguist <u>that has two cats</u> cleaned the litter boxes. B_{RC}: #No, she doesn't.

(5) [Context: Tiffany has two housemates.]
   A: Tiffany took stats with the housemate <u>that is a happy soul</u>. B_{RC}: No, he isn't.

The current study can thus be viewed as part of a larger program addressing the question of what factors influence the availability of a referent for anaphora resolution, which has been extensively studied with respect to personal pronouns. The contribution of the present paper regarding this endeavor is twofold. First, the current study examines factors that have received little attention, namely the pragmatic status of the content with which a referent is introduced, as well as effects of discourse relations. Second, the experiments extend the empirical domain to propositional pronouns, which have not been studied experimentally. As the discussion above illustrates, anaphors play a big role in developing our theories of meaning such that understanding what determines a referent's anaphoric potential may have broader implications.

The paper is structured as follows. Section 2 provides the background on the relevant findings by Syrett and Koev (2015) that play an important role in the discussion, as well as the accounts of their findings. These accounts will then be tested in two experiments in section 3. Section 4 contains the general discussion of the experimental results and section 5 concludes the paper.

2. Background

2.1. Syrett and Koev (2015): Positional Effect of ARCs

Syrett and Koev (2015) (henceforth S&K) report two experiments that manipulated the syntactic position of an ARC in the sentence. In their Experiment 2, S&K compared medial ARCs as in (6) to the final counterpart in (7) (both underlined) with respect to their availability for a direct denial.[2] For each item, participants were given two choices, with each option unambiguously targeting either the main clause or the ARC (for instance by virtue of tense (6) or a number (mis-)match (7)). The results indicated that final ARCs were more likely to be chosen as the target of the direct denial than their medial counterpart, receiving 35% of the choices compared to 21% for the medial ARC. Notably, while this difference was significant, the main clause thus remained to be the preferred choice even with final ARCs.

(6) A: My friend Sophie, who performed a piece by Mozart, is a classical violinist.
B_{MC}: No, she's not.
B_{RC}: No, she didn't.

(7) A: The symphony hired my friend Sophie, who performed a piece by Mozart.
B_{MC}: No, she didn't.
B_{RC}: No, they didn't.

In their Experiment 3, S&K used elliptical *why*-questions in a similar configuration, again varying the position of the ARC, as shown in (8). Each item was followed by the one-word question *Why?* and two possible responses, whose content targeted either the main clause (9a) or the ARC (9b). While medial ARCs were chosen as the target only 30% of the time, final ARCs received 67% of the responses. Thus, in contrast to Experiment 2, this suggests that final ARCs are not only more available than medial ones but may also be preferred over the main clause (at least numerically, given that S&K did not explicitly test whether the 67% differed from chance). I will come back to this issue in the general discussion in section 4.

(8) a. Chloe, who decided to dress in a classical ballet style, has been chosen to audition for the 'All Stars' Dance Company.
b. The 'All Stars' Dance Company has chosen to audition Chloe, who decided to dress in a classical ballet style.

(9) Choices for answer to *Why?* question
a. *Main clause target*:
Because they think Chloe could be a good addition to their company.
b. *Appositive target*:
Because she wants to be taken seriously as a classical ballet dancer.

S&K's proposed explanation for the special status of final ARCs is that they are structurally ambiguous. While both medial and final ARCs can attach to the head noun (10)-(11a), final

[2]This experiment also included nominal appositives, which will not be discussed here.

ARCs additionally allow attachment on a clausal level, likening them to coordinated structures (11b). By virtue of being the last assertion made in this configuration, following that of the main clause rather than being embedded inside it, the final ARC becomes available for direct denials or *why*-ellipsis.

(10) my friend [$_{DP}$ Sophie [$_{CP}$ who is a classical violinist]] performed a piece by Mozart

(11) a. the symphony hired my friend [$_{DP}$ Sophie [$_{CP}$ who is a classical violinist]]
b. [$_{CP1}$ the symphony hired my friend Sophie] [$_{CP2}$ who is a classical violinist]

2.2. Accounts of the Positional Effect

2.2.1. Frazier et al. (2017): Speech Act Account

Frazier et al. provide an essentially pragmatic explanation for the special status of final appositives. Their account resembles that of S&K in that it involves a recency component but differs in remaining agnostic with respect to the syntax involved.[3] The authors argue that ARCs differ from RRCs in contributing quasi-independent speech acts, on a par with that of a root clause. Evidence for this view comes from contrasts such as (12), showing that only ARCs are able to felicitously host speech-act adverbs such as *hereby*. The special status of final ARCs is then accounted for—in a vein similar to S&K—in terms of recency. Final ARCs constitute the most recent speech act, whereas medial ARCs do not, due to being followed by part of the matrix clause, and it is this recency effect that makes final ARCs more available for certain kinds of anaphora.

(12) a. This boy, who I **hereby** christen Jonathon, will grow up to be a giant among men.
b. #This boy that I **hereby** christen Jonathon will grow up to be a giant among men.

The speech act account thus involves the interplay of two properties: ARCs contributing a quasi-independent speech act, and their position in the sentence. Since only ARCs contribute quasi-independent speech acts while RRCs do not, the speech act account predicts that only final *appositives* have a special status while RRCs should bear less anaphoric potential relative to ARCs. Relating this reasoning back to the discussion in section 1, the idea is that this difference in terms of the speech act potential is what modulates anaphoric potential, rather than at-issueness. This prediction will be tested in the first experiment presented in section 3.1.

2.2.2. Jasinskaja (2016), Hunter and Asher (2016): Discourse Structure Account

A different proposal for the positional effect comes from Jasinskaja, and Hunter and Asher, who I will discuss jointly since the gist of their accounts is rather similar. Their proposal is embedded in the framework of Segmented Discourse Representation Theory (SDRT, Asher and Lascarides, 2003). On this view, a discourse can be represented as a tree (or graph) with discourse units–which, simplifyingly, correspond to clauses–being connected by different types of discourse relations. Similar to other approaches to discourse coherence such as Kehler's

[3] I will put S&K's account aside for now given that the syntax of ARCs is less than clear (see for instance discussion and experimental results in Dillon et al., 2018).

(2002) Coherence Theory, discourse relations differ in terms of their content, which is captured by conditions like (13a) and (14a). The mini-discourses in (13b) and (14b) illustrate the relations of ELABORATION and NARRATION respectively, with the former marking the eventuality of ϕ_2 as being part of the eventuality of ϕ_1 (eating salmon was part of Nick's lovely meal) and the latter indicating temporal precedence (Julie sat down *after* she entered the room).

(13) a. *Condition of Elaboration*: ELABORATION(ϕ_1,ϕ_2) iff $\varepsilon_{\phi 2} \in \varepsilon_{\phi 1}$
b. [Nick had a lovely meal last night.]$_{\phi 1}$ [He ate lots of salmon.]$_{\phi 2}$

(14) a. *Condition of Narration*: NARRATION(ϕ_1,ϕ_2) iff $\varepsilon_{\phi 2} > \varepsilon_{\phi 1}$
b. [Julie entered the room.]$_{\phi 1}$ [She sat down.]$_{\phi 2}$

However, discourse relations do not only differ in *content* but also in the *structure* they give rise to and how this in turn affects the accessibility of a clause for anaphoric reference. The core idea is illustrated in Figure 1. Discourse relations can either be *subordinating* or *coordinating*. If the relation is subordinating, both clauses will be in principle accessible for attachment of a new discourse unit. In contrast, if the relation is coordinating, the first unit is blocked by the second unit and thus ceteris paribus inaccessible for discourse continuations. This idea is referred to as the Right Frontier Constraint (RFC) (Polanyi, 1988) in (15).

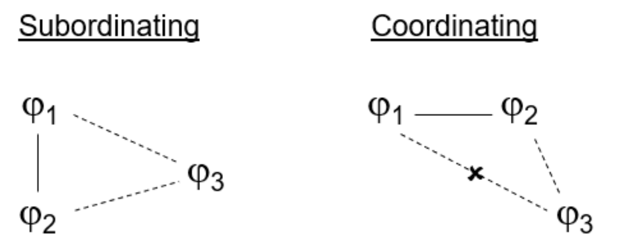

Figure 1: Illustration of Right Frontier Constraint

(15) Right Frontier Constraint (simplified)
Only discourse units on the right edge of a discourse structure are available for discourse continuations.

The empirical consequence of the RFC is illustrated in (16). Depending on the discourse relation between ϕ_1 and ϕ_2—with ELABORATION in (16b) being subordinating and NARRATION in (16c) coordinating—referring back to the quarterback in (16d) becomes more or less felicitous.

(16) a. [At half-time, **the quarterback** waved at the fans.]$_{\phi 1}$
b. [The cheerleader was encouraging them to support the team.]$_{\phi 2a}$
c. [Then the cheerleader encouraged them to support the team.]$_{\phi 2b}$
d. [**He** later scored a touchdown.]$_{\phi 3}$ *(✓ after (16b), # after (16c))*

On a discourse structure account, final ARCs are special because they are on the right edge of a discourse tree, and more accessible than the matrix clause if in a coordinating relation to it. Medial ARCs, on the other hand, will never be on the right edge because of the way the discourse structure is updated incrementally. By assumption, the Right Frontier consists of the last processed discourse unit and any unit above (= superordinate to) it. Moreover, medial ARCs seem to be restricted to subordinating relations, illustrated in (17). Adding *then* to mark the coordinating relation NARRATION in (17a) appears to be infelicitous, whereas it is acceptable in the final ARC in (17b). Therefore, since medial ARCs are neither the last discourse unit nor above it, they will not be at the Right Frontier and therefore inaccessible.

(17) a. Thuy, who (#then) went home, left her keys at the department.
b. Thuy texted Karo, who (then) brought her her keys.

An immediate practical concern that this account raises is how to determine whether a discourse relation is subordinating or coordinating, or more generally why certain relations are one or the other. As Asher and Vieu (2005) note, discourse relations have often been impressionistically categorized as belonging to either group without being tied to reliable diagnostics, resulting in heterogeneous lists without an obvious common denominator. While finding an answer to the question of what underlies the subordinating-coordinating distinction is an important task, I will put this question aside for the current study and adopt a view of the RFC as an empirical generalization: certain discourse relations render previous material less available for anaphoric reference. To further explore this generalization, I will follow Asher and Vieu in taking ELABORATION and NARRATION to be stereotypical examples of subordinating and coordinating relations respectively, which the following experiments can be modeled after.

Before moving on to the experimental studies, one further qualification regarding the RFC is in order. In the current formulation, the RFC sounds rather absolute. However, a more accurate way to conceive of it would be as a violable constraint, or a preferential bias that interacts with similar biases that have been shown to be relevant for the interpretation of anaphoric dependencies, like topicality or Focus. This conception is supported by an experimental study by Holler and Irmen (2007), who investigated the effect of the RFC by looking at how participants interpret an ambiguous pronoun when only one antecedent is available at the Right frontier or both of them are. The experiment included a gender manipulation of the second antecedent as a control, to see what happens in the absence of ambiguity. The results showed an effect of the RFC such that there was an increase of second antecedent choices when it was the only one available at the Right frontier compared to the other two conditions. However, this increase did not go as far as rendering the second antecedent the preferred choice but only put it on a par with the first antecedent, which was (numerically) preferred in the two other conditions (65% and 67% respectively). Thus, the RFC has an effect on pronoun resolution preferences but does not override other biases that may be relevant, for instance a construal of the first antecedent as topical. Moreover, the unambiguous controls were almost exclusively resolved to the gender matching antecedent, indicating that the RFC can be overridden in the face of constraints that are evidently grammatically, such as a morphologically marked gender feature, whereas it is an open question whether we should think of the RFC as part of the grammar or rooted in processing (or both).

Thinking of the RFC as a preference rather than an absolute lets us also make better sense of the findings by S&K and the proposed explanation in Jasinskaja (2016). In a subordinating configuration – that is, when both matrix clause and ARC are on the Right Frontier – all the RFC states is that both segments are available for continuation. However, at least in Experiment 2, S&K found a strong preference for the matrix clause even when the ARC was final. To account for this apparent bias, Jasinskaja makes reference to the Main Assertion Hypothesis proposed by Frazier and Clifton (2005) in (18). Even though the Main Assertion Hypothesis is an information-structural constraint rather than a syntactic one, syntactic information can still be used to identify what constitutes the main assertion of a complex sentence, with a clause that is higher in the syntactic structure constituting a better candidate prima facie. Thus, taking both the RFC and the Main Assertion into account provides a possible explanation for the findings by S&K.[4] Therefore, I will assume that the matrix clause constitutes the default choice and will mainly be concerned with the effects that discourse structure can have with respect to this baseline.

(18) Main Assertion Hypothesis
Other things equal, comprehenders prefer to relate material in a new sentence to the main assertion of the preceding sentence.

The prediction of the discourse structure account that will be tested in the following experiments is that the discourse relation between the matrix clause and the final relative clause should affect their anaphoric potential by virtue of the RFC. While in a subordinating relation, both matrix clause and relative clause should be in principle accessible, with a preference for the matrix clause as the Main Assertion, a coordinating relation should make the matrix clause less accessible, and in turn the relative clause more so.

3. Experiments

3.1. Experiment 1

The goal of the first experiment is to test the predictions of the speech act account and the discourse structure account respectively, which were laid out in the previous section. According to the speech act account, final ARCs are special because they contribute the most recent speech act. Since RRCs differ from ARCs in not contributing a speech act on their own, the prediction is that ARCs will be more available for anaphoric reference than RRCs, which will be tested by comparing the two types of relative clauses.

On the discourse structure account, final ARCs contribute discourse segments that are available for anaphoric reference. Appealing to the RFC, this view predicts the discourse relation between a matrix clause and final relative clause to play a crucial role for anaphora resolution. If the relation is subordinating, both matrix clause and relative clause are available for discourse attachment but the matrix clause assumed to be preferred due to contributing the Main Assertion. For coordinating relations, however, the matrix clause is expected to become less available since it is no longer on the Right Frontier, in turn raising the anaphoric potential of the relative clause. This prediction will be tested by manipulating the discourse relation between matrix and relative clause. I will follow Jasinskaja (2016) in assuming that relative clauses stand in an ELABORATION relation—the stereotypical subordinating relation according to Asher and Vieu (2005)—to the matrix clause by default. The coordinating counterpart will be modeled after the stereotypically coordinating NARRATION relation, which will be assumed to be marked by temporal adverbs such as *then*. Additionally, the experiment will make use of grammatical aspect as cues for discourse relations. While the imperfectivity of the progressive seems to be a natural fit to express the part-whole relation of ELABORATION, perfective aspect is cross-linguistically associated with narrative progression and therefore NARRATION.

[4] With respect to the experiment on *why*?-ellipsis where S&K found a numerical preference for the ARC, one possible explanation might be that response particles and ellipsis differ in how they rank the different factors that contribute to the anaphoric potential of their antecedent, with ellipsis caring more about recency than the Main Assertion.

Moreover, combining temporal adverbs like *then* with progressive aspect, as in (19a), seems not fully acceptable.

(19) a. Tiffany took a ride with Karo, who was (??**then**) getting cake.
b. Tiffany took a ride with Karo, who (**then**) got cake.

In addition to these two factors—relative clause type and type of discourse relation—, the experiment also aims to explore to what extent different kind of anaphora may vary in their sensitivity to the manipulated factors. As discussed in the introduction, the deniability test may be viewed as detecting the anaphoric potential of a proposition, in our case the proposition contributed by an ARC. A question one might ask is whether propositional anaphors behave differently from other anaphoric devices in this respect, for instance personal pronouns. Some suggestive evidence that types of anaphora differ in what properties of their antecedent they are sensitive to comes from the Syrett and Koev experiments discussed in section 2.1. While the final ARC remained the dispreferred option compared to the main clause with respect to direct denials, the use of *why*-ellipsis rendered the final ARC the preferred choice. This difference might have been due to a number of factors, such as particular properties of the items used in the two experiments, but it might also suggest that direct denials differ from *why*-ellipsis in how they weigh the factors that determine their referent. For instance, direct denial could care more about what the Main Assertion is, while *why*-ellipsis is primarily determined by recency. In the context of our current investigation, we might then ask how the different factors might interact with anaphora type, specifically those that take propositions versus those that refer to individuals.

The discourse structure account is concerned with discourse attachment in general rather than being restricted to particular anaphoric devices or even anaphoric reference in general. The use of anaphoric devices is primarily for convenience to unambiguously mark where in the discourse a new segment attaches.[5] We would thus not expect the discourse relation manipulation to be restricted to a particular kind of anaphor. With respect to the relative clause type manipulation, one might wonder whether the illocutionary force of ARCs affects the proposition it embeds more than any individual-level discourse referents that are being introduced with it. However, it should be noted that this remains speculative and the comparison of propositional anaphors with personal pronouns an exploratory aspect of the following experiment.

3.1.1. Design and Materials

The first experiment manipulated the three factors discussed in the previous section—RELATIVE CLAUSE TYPE (**restrictive** vs **appositive**), DISCOURSE RELATION (<u>subordinating</u> vs <u>coordinating</u>) and PRONOUN TYPE (*personal* vs *propositional*)—in a 2x2x2 design, yielding 8 conditions. All items consisted of two sentences, the first with a final relative clause and the second containing the target pronoun. A sample item is shown in (20).

[5] It should be noted that this is a simplification. A new discourse segment containing an anaphor does not have to attach directly to the segment it gets its antecedent from but for the discourses we will be concerned with here we can put these cases aside for now.

(20) a. **Restrictive** – Subordinating - *Personal/Propositional*
At the open house, the real estate lady haggled with the potential tenants **that** the landlady was selling some furniture to.
She/That was geemish.

b. **Appositive** – Subordinating - *Personal/Propositional*
At the open house, the real estate lady haggled with the potential tenants, **who** the landlady was selling some furniture to.[6]
She/That was geemish.

c. **Restrictive** – Coordinating - *Personal/Propositional*
At the open house, the real estate lady haggled with the potential tenants **that** the landlady then sold some furniture to.
She/That was geemish.

d. **Appositive** – Coordinating - *Personal/Propositional*
At the open house, the real estate lady haggled with the potential tenants, **who** the landlady then sold some furniture to.
She/That was geemish.

RC-TYPE was manipulated via the relative pronoun (*that* = **restrictive**, *who* = **appositive**), with a comma in the appositive conditions to mark an intonational break. To manipulate the DISCOURSE RELATION between matrix and relative clause, the aspect of the verb in the relative clause was varied between past progressive (subordinating) and simple past (coordinating), in addition to one of three temporal adverbs (*then*, *later*, *afterwards*)[7] in the *coordinating* condition, which were evenly balanced across items. As PRONOUN TYPES, the target sentence contained either a personal pronoun (*s/he*) or the propositional pronoun *that*. As antecedents for the personal pronoun, each clause contained a DP matching in grammatical or stereotypical gender, both in subject position to prevent biases due to grammatical role. The relative clause head noun was excluded as a potential antecedent for the pronoun via number mismatch. To avoid plausibility confounds, the target sentence always contained a nonce-word like *geemish* that was different for each item. There were 24 items of this type and 24 fillers, most of which were unambiguous.

The items were designed in such a way to avoid the possibility of a causal interpretation, particularly a RESULT reading that would be compatible with the temporal progression indicated by *then* (results precede their cause rather than follow it). However, it should be noted that RESULT is standardly considered coordinating as well such that a discourse structure account would predict it to behave similarly to NARRATION. I will take up this issue in the general discussion.

[6] It is worth noting that trying to mark an RRC with a coordinating relation results in a decrease in acceptability. This markedness may be related to the previously discussed data in (12) showing an incompatibility between RRCs and speech act adverbials. This condition was nonetheless included to keep the design balanced but should be taken with a grain of salt when evaluating the results.

[7] While *then* is standardly used as a NARRATION marker in the literature, the other temporal adverbs were used to add some superficial variation across items, on the assumption that they all indicate temporal progression. Although the results indicated no obvious differences among these three adverbs, ongoing work on how the RFC affects online processing suggests otherwise, with *then* as the most reliable indicator of a coordinating relation. These differences are in line with Asher and Lascarides' (2003) characterization of NARRATION as requiring a common discourse topic on top of temporal progression. I will leave this issue for future research (but see Anand and Toosarvandani, this volume, for a formal account of *then*).

A potential issue with using *that* as a propositional pronoun here is that it could also be taken to refer to the first sentence as a whole rather than just the matrix or just the relative clause. While this is a legitimate worry, the experiment is primarily concerned with how the factors affect the availability of (the material in) the relative clause, taking the matrix clause—whether on its own or including the relative clause—as a baseline.

3.1.2. Participants

We recruited 48 subjects from Amazon Mechanical Turk to participate in the study. Each participant was paid $2.50. The experiment lasted approximately 15-20 minutes.

3.1.3. Procedure

Each item was presented to each participant with a question targeting the clause containing the pronoun, for example *Who/What was geemish?* for (20), and two response options corresponding to the matrix clause (antecedent) and the relative clause (antecedent) respectively. Again using (20) as illustration, for the personal pronoun the options would have been *The real estate lady* or *The landlady*, for the propositional pronoun *That the real estate lady haggled with the potential tenants* or *That the landlady was selling/sold furniture to the potential tenants*.

Additionally, the experiment included an exit poll to probe the concern regarding the ambiguity of *that*. Participants were given an instance of a restrictive subordinating item and an appositive subordinating item with answer options corresponding to what can be considered the simple interpretation (as shown above) and the complex interpretation (i.e. *That the real estate lady haggled with the potential tenants that the landlady was selling furniture to*), as well as a "No Response" option if they thought they rarely chose the matrix clause option during the experiment. This poll was intended to see whether participants interpreted *that* as referring to the matrix clause on its own or the whole sentence, as well as to what extent the type of relative clause affected the interpretation.

3.1.4. Predictions

Now that the design has been laid out, let's take a look at how the predictions of the speech act account and the discourse structure account mentioned above would translate to the experiment. First, the speech act account predicts an increase of RC-choices for ARCs compared to RRCs. Second, the discourse structure account predicts more RC-choices with coordinating relations than subordinating ones. More tentatively, we might see an interaction between RELATIVE CLAUSE TYPE and PRONOUN TYPE if propositional anaphors are more sensitive to the illocutionary force of ARCs than personal pronouns.

3.1.5. Results

The results, shown in Figure 2, were analyzed with a mixed-effects logistic regression model via sum coding with a maximal random effect structures (Barr et al., 2013). All three main effects were significant. First, ARCs received more RC-choices than RRCs ($z = 4.21$, $p < .001$). Second, coordinating relations increased RC-choices compared to subordinating relations ($z = 4.34$, $p < .001$). Third, there were more RC-choices for propositional anaphors than for personal pronouns ($z = 2.06$, $p < .05$). Additionally, there was a significant interaction between RC-TYPE and DISCOURSE RELATION ($z = 1.98$, $p < .05$) with the increase of coordinating relations being more pronounced with ARCs compared to RRCs.

Regarding the exit poll targeting the interpretation of the MC-choice, there were 26 complex interpretations for the restrictive item (13 simple, 2 no response) and 20 for the appositive (19 simple, 2 no response). 7 responses were lost to a coding error.

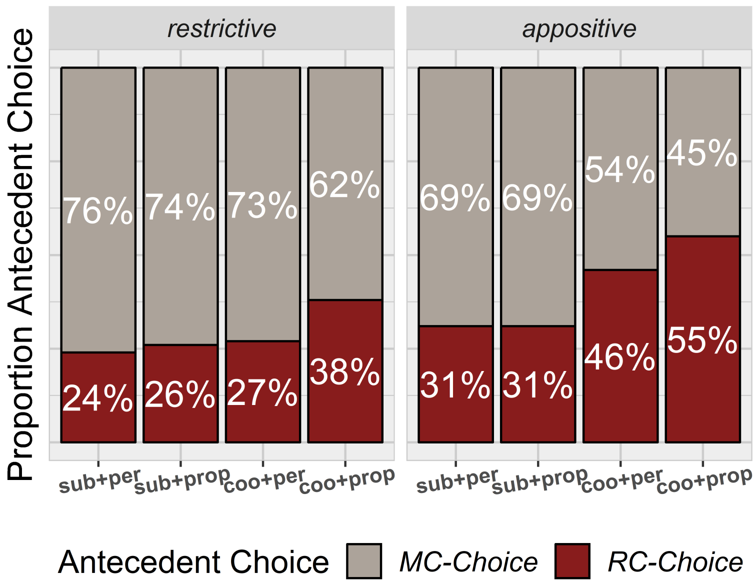

Figure 2: Proportion Antecedent Choices by Condition split by RC-Type, Experiment 1 (sub = subordinating, coo = coordinating, per = personal, prop = propositional)

3.1.6. Discussion

The results provided support for both accounts. Appositives were more likely to be chosen as antecedent than restrictives (41% vs 29%, pooling across conditions), in support of the speech act account, and coordinating relations increased the likelihood of RC-choices (41% vs 28% for subordinating), providing evidence for the discourse structure account. Moreover, the two factors interacted with each other such that the coordinating effect was more pronounced for appositives than for restrictives (19.5% difference for appositives vs 7.5% for restrictives). Thus, the results suggest that both factors need to be taken into account for determining the availability of final relative clauses and may in fact inform each other. As was mentioned in the introduction, the two accounts do not have to be viewed as mutually exclusive but rather as two different perspectives on the same phenomenon. One potentially promising way of bringing the two accounts together could be to think of the properties of appositives (i.e. contributing a quasi-independent speech act) as providing cues for the construction of the discourse structure. That is, appositives are more likely to be perceived as distinct discourse units and thereby more likely to be chosen for attachment. Some suggestive evidence for this idea comes from the exit poll data, which indicated a trend towards perceiving the matrix clause choice as simple (i.e. distinct from the RC) when dealing with an appositive compared to a restrictive.

A result that is less straightforwardly explained concerns the increased likelihood of RC-choices for propositional anaphors compared to personal pronouns. In the absence of a significant interaction with either RC-type or discourse relation, this result cannot be accounted for by appealing to a difference in sensitivity to either of the factors, as it was framed previously. Rather, one would have to appeal to a more general recency kind of effect, with propositional anaphors being more likely to find their antecedent in the most recent clause than personal pronouns. However, a closer look at the data shows that the difference between anaphor types seems to be restricted to coordinating relations (10% difference vs 1% for subordinating relations). Since the relevant interaction was non-significant however ($z = 1.6$, $p = 0.11$), potentially due to a lack of power, attributing the pronoun type effect to this corner of the data must be treated as speculative. Moreover, even if we were to accept this interpretation, we are still left with the question why the different pronoun types should show a different sensitivity to the discourse structure.[8]

To further investigate this pattern in the data, we conducted a follow-up experiment.

3.2. Experiment 2

This experiment was meant to test whether the suspicious pronoun type pattern in Experiment 1 was merely accidental or in fact reliable.

3.2.1. Design and Materials

The design was the same as for Experiment 1, except that only appositives were included, given that the discussed pattern concerned the interplay of discourse relation with pronoun type, to increase statistical power. Additionally, half the items, which were identified as allowing a causal inference (see footnote 8), were fixed. A sample item is shown in (21).

(21) a. <u>Subordinating</u> - *Personal/Propositional*
At the open house, the real estate lady haggled with the potential tenants,
who the landlady <u>was selling</u> some furniture to.
She/That was geemish.

b. <u>Coordinating</u> - *Personal/Propositional*
At the open house, the real estate lady haggled with the potential tenants,
who the landlady <u>then sold</u> some furniture to.
She/That was geemish.

[8] A potential clue for an explanation comes from a post-hoc item comparison. Despite the noted objective to avoid the possibility of any causal inferences in the items, half of the items were still compatible with either an EXPLANATION relation (n=4) or a RESULT relation (n=8). It seemed that those items showed no difference between pronoun types for the appositive coordinating conditions, while the remaining non-causal items showed a 20% difference. However, since this effect was not present in Experiment 2, it won't be discussed further.

3.2.2. Participants

We recruited 48 subjects from Amazon Mechanical Turk to participate in the study. Each participant was paid \$2.50. The experiment lasted approximately 15-20 minutes.

3.2.3. Procedure

The procedure was the same as for Experiment 1, except for the lack of an exit poll since the items did no longer include a comparison between RRCs and ARCs.

3.2.4. Predictions

In line with the results from Experiment 1, coordinating relations were predicted to increase RC-choices. More critically, if the pattern from Experiment 1 is real and propositional anaphors are more sensitive to the discourse relation effect, the interaction between the two factors is expected to be significant this time.

3.2.5. Results

The data, shown in Figure 3, were again analyzed using mixed-effects logistics regression. While the effect of DISCOURSE RELATION was replicated ($z = 1.98$, $p < .05$), PRONOUN-TYPE was no longer a significant factor. The critical interaction did not reach significance either.

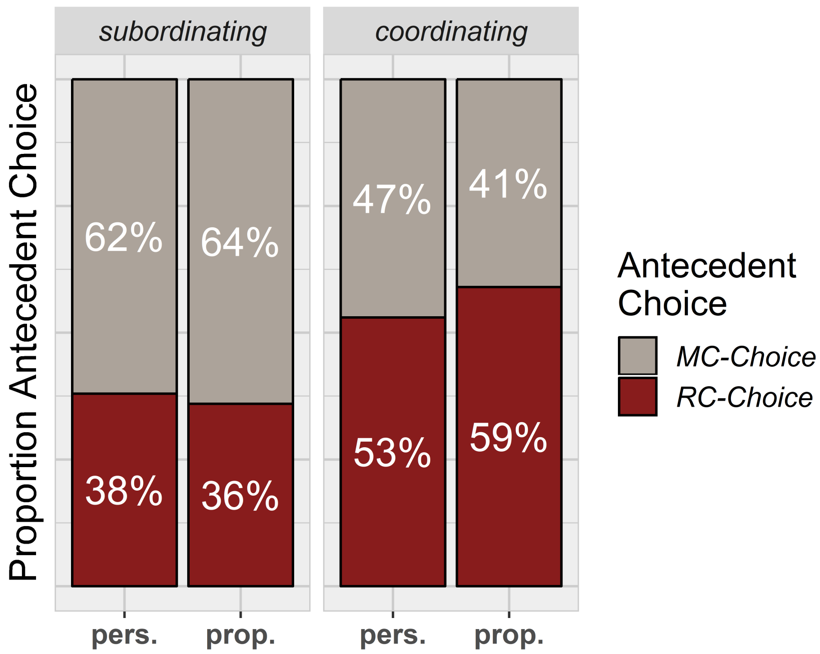

Figure 3: Proportion Antecedent Choices by Condition split by Discourse Relation, Exp 2 (pers = personal, prop = propositional)

3.2.6. Discussion

As in Experiment 1, coordinating relations increased the likelihood of RC-choice, replicating the discourse relation effect and providing further evidence for the RFC. However, there was no longer a significant difference between pronoun types, nor any sign of an interaction. This suggests that the pattern in Experiment 1 was only accidental and not indicative of any deeper difference between propositional anaphors and personal pronouns. While evidence for such a difference might have been informative, it is not supported by the data and therefore remains speculative. I will leave further investigations for future research and turn to the general discussion of the two experiments.

4. General Discussion

The two experiments provided support for both accounts of the special status of final appositives. ARCs were more likely to be chosen as an antecedent than RRCs in Experiment 1, providing evidence for the speech act account and the relevance of illocutionary force for anaphora resolution. Experiments 1 and 2 furthermore supported the discourse structure account by showing that relative clauses standing in a NARRATION relation to the matrix clause increased the number of relative clause choices compared to ELABORATION relations. These results also constitute experimental evidence for the Right Frontier Constraint, in line with Holler and Irmen (2007), in that NARRATION qua coordinating relation rendered its first argument—the main clause—less accessible, as indicated by pronoun interpretations. Taken together, the data argue for a picture in which multiple factors contribute to the anaphoric potential of an antecedent.

In addition to the individual contributions of relative clause type and discourse relation, Experiment 1 showed a significant interaction such that the discourse relation effect was amplified for ARCs rather than being purely additive. This result suggests that the syntactic-pragmatic properties of the relative clause affect how the discourse structure is determined. There are (at least) two possible avenues for conceptualizing such an interaction. The first option would be that syntactic-pragmatic properties are taken into consideration for identifying what counts as a discourse *unit*. That is, we might imagine that ARCs contributing quasi-independent speech acts are more likely to be perceived as a separate unit than syntactically integrated RRCs might be. A second possibility would be that the properties of the relative clause factor into inferring the discourse *relation*, with RRCs being more standardly taken as ELABORATION and therefore subordinating.

Suggestive evidence for the first option comes from the exit poll of Experiment 1. There was a numerical trend of participants being more likely to interpret *that* as referring to the whole sentence encompassing matrix and relative clause when the relative clause was restrictive compared to it being appositive. Although not the main focus of this paper, these data suggest a novel diagnostic for distinguishing restrictive from appositive relative clauses, and potentially the degree of syntactic integration of a clause more generally. To what extent the interpretation of propositional anaphors can serve as a diagnostic in this regard and the question of how syntactic properties of clauses interact with discourse relations will be left to future research.

As an exploratory component, the two experiments also addressed the question of how different kind of anaphora might differ in their sensitivity to particular properties of their antecedents.

In Experiment 1, propositional anaphors were more likely to be interpreted as referring to (an antecedent in) the relative clause than personal pronouns. A possible explanation for this effect could have been that propositional anaphors are more sensitive to recency. However, the numerical pattern of the data suggested that the difference in anaphora types resided in their sensitivity to the discourse relation manipulation. However, the results from Experiment 2 lacked such a pattern, as well as the overall difference between anaphora types. Since Experiment 2 had more statistical power by virtue of having only four conditions instead of eight, any interpretation of the pattern in Experiment 1 has to remain speculative. On the other hand, it suggests that the relevant factors affect individual-level and propositional-level referents similarly. Nonetheless, coming back to the indirect contrast between response particles and *why*-ellipsis found by Syrett and Koev (2015), considering a wider range of anaphoric expressions in similar paradigms might serve a fruitful area of research, for instance extending the approach taken here to VP-ellipsis, which might be taken as being more rooted in syntax and therefore more sensitive to syntactic factors.

While the experiments presented here provided data relevant to the questions outlined above, it is also important to note the caveats and restrictions that apply to their interpretation. First, the investigation was restricted to the two stereotypically subordinating and coordinating relations, ELABORATION and NARRATION. It is an open question to what extent other relations that have been categorized as subordinating or coordinating, such as EXPLANATION or CONTRAST respectively, would show the same effect. Extending the picture to other relations might be informative to determine whether the effects are something about the specific relations or about the subordinating-coordinating distinction more generally.

Relatedly, the results do not bear on the question of what underlies this particular distinction and the Right Frontier Constraint. While it seems hardly possible to find a common denominator for what makes a discourse relation subordinating or coordinating, Jasinskaja and Karagjosova (to appear) have argued that subordinating relations all address a grounding problem by providing information that ensures that a speaker's intention can be recognized. This view might provide a connection to other approaches to discourse structure such as the QUD-framework of Roberts (1996/2012) or the Table Model of Farkas and Bruce (2010), to model how particular issues are related and need to be resolved before the discourse can proceed.

Finally, the experimental design was restricted to a particular kind of continuation sentence, namely simple predicative copula sentences. While this continuation was treated as a neutral baseline, it seems possible that not only the discourse relation between matrix and relative clause plays a role but also the content, and along with it the relation established with the following sentence. Support for this view comes from data reported in Kehler et al. (2008) with respect to implicit causality verbs showing that the relation between two clauses/sentences affects the interpretation of an ambiguous pronoun contained in the second clause. Although the studies presented here were concerned with how the relation between two clauses affects the interpretation of a pronoun in a *third* clause, it seems thus possible that the discourse relation between the first/second clause and the third clause might introduce biases on their own. Moreover, since participants not only need to find an antecedent for the pronoun but also make a decision with respect to where to attach the third clause in the discourse structure—tasks that might very well be strongly dependent on each other—these effects might also be viewed in terms of discourse attachment biases. I will leave further investigation of these issues to future research.

5. Conclusion

This paper presented two offline binary forced-choice interpretation experiments aimed at testing the predictions of two accounts of the special status of final appositive relative clauses, namely the speech act account and the discourse structure account. The speech act account was supported by the results of Experiment 1, which showed that both individual-level and propositional-level entities introduced via an appositive relative clause were more likely to be chosen as antecedent than via a corresponding restrictive relative clause. This effect suggests that the quasi-independent speech act contributed by an appositive increases the anaphoric potential of the material it introduces. The discourse structure account was also supported by the fact that in both experiments the coordinating relation NARRATION between matrix clause and relative clause increased choices for the relative clause antecedent, thus providing experimental evidence for the validity of the Right Frontier Constraint with respect to two types of anaphoric expressions. While the comparison between individual-level and propositional-level anaphora was only significant in one experiment, it will remain an open question to what extent different kinds of anaphora are differentially sensitive to factors like illocutionary force or discourse relations. Furthermore, Experiment 1 showed that the contribution of relative clause type and discourse relation was not purely additive but interactive, with appositives increasing the effect of NARRATION. I proposed two possible ways of drawing a connection between these two properties, one focusing on the way syntactic-pragmatic properties guide the segmentation of the parts of a discourse, another on how these properties might affect which discourse relation gets established. Addressing these issues, as well as extending the empirical landscape to different anaphors and discourse relations will be the next step to further develop a theory of how discourses are built and reference gets established.

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High negation questions and epistemic bias[1]

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Abstract. High negation questions—questions like "Isn't it nice out?"—necessarily convey that the speaker is epistemically biased, i.e., the speaker has a prior belief about the correct answer to the question. In particular, the speaker necessarily expresses bias toward the proposition embedded under the high negation. Low negation questions, on the other hand, do not necessarily convey this bias. Romero and Han (2004) demonstrate that this asymmetry holds in several languages, some unrelated. This remarkable crosslinguistic fact merits explanation. In particular, what role does the structural height of negation play in triggering this epistemic bias? In this paper, I present novel evidence demonstrating that high negation questions lack propositional negation. This evidence is taken to support Ladd's (1981) suggestion that high negation is somehow outside of the proposition, and is used to motivate an analysis in which high negation scopes above an epistemic operator. I argue that this analysis of high negation enables a novel account of epistemic bias that predicts its context insensitivity.

Keywords: polar questions, negation, biased questions.

1. Introduction

Classic theories of question semantics treat polar questions such as (1a) as a set of propositions representing the positive and negative answers, as in (2) (e.g., Hamblin, 1973; Karttunen, 1977; Groenendijk and Stokhof, 1984). Assuming that double negation of a proposition is equivalent to the proposition itself (i.e., $\neg\neg p = p$), a puzzle for such a view is that the addition of negation to a polar question, as in (1b) and (1c), is predicted to result in the same set of propositions, despite that the meanings of such questions are clearly different in some sense (e.g., Büring and Gunlogson, 2000).

(1) a. Is Moira home?
    b. Isn't Moira home?
    c. Is Moira not home?
    d. IS Moira home?

(2) {*that Moira is home, that Moira is not home*}

In this paper, I will demonstrate empirical differences between the different kinds of polar questions in (1) (section 2). In particular, I will focus on high negation questions—questions in which negation is preposed with the auxiliary like (1b)—which necessarily convey that the speaker is epistemically biased, i.e., the speaker has a prior bias toward the proposition embedded under the high negation, *that Moira is home*. Verum/polarity focus questions like (1d) convey a similar bias—but toward the negative answer *that Moira is not home*—though I will argue that this is for distinct reasons. Low negation questions like (1c) lack epistemic bias.

Romero and Han (2004) demonstrate that the asymmetry between high and low negation questions holds in several languages, some unrelated. This is a remarkable crosslinguistic fact that merits a deep explanation. Why would a high structural position for negation in a polar ques-

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tion give rise to a strong inference that the speaker is biased toward the propositional core of the question?

I present novel evidence demonstrating that high negation questions lack propositional negation (section 3). This evidence is taken to support Ladd's suggestion that high negation is somehow outside of the proposition (Ladd, 1981). I argue that this is due to negation scoping over an epistemic operator O. This structure denotes an unbalanced partition $\{Op, \neg Op\}$, consistent with previous proposals (section 4; e.g. Romero and Han, 2004; Repp, 2013; Krifka, 2017).

The remaining question is why does such a denotation result in the inference that the speaker is biased for the proposition embedded under the high negation? I develop a novel pragmatic account of this inference, arguing that it follows from the way in which the partition is unbalanced, and general pragmatic principles governing the asking of questions (section 5). The resulting account provides an explanation for the crosslinguistic link between structural height, negation, and speaker bias.

Another way to see the present work is that I am building on—but substantially revising—the approach of Romero and Han (2004). The key insight preserved from Romero and Han's theory is that high negation questions contain an epistemic or doxastic operator that composes with the rest of the structure to yield an unbalanced partition. The revisions I argue for result from two sets of novel empirical evidence. The first is that there are empirical asymmetries between high negation and verum/polarity focus, which lead me to conclude that a unified account of the two phenomena is untenable (section 2.2). The second is that high negation questions are not ambiguous between inner and outer negation readings (section 3), but instead only have the outer negation structure and interpretation (section 4). I will show that these revisions yield a happy result: the bias associated with high negation questions can be given a novel derivation that flows from the way in which the partition is unbalanced (section 5). Without these revisions, such a derivation could not be given.

2. Empirical facts distinguishing types of polar questions

2.1. High vs. low negation questions

(3) A has just walked in the front door, and she is looking for her roommate Moira. She has no idea whether Moira is home or not, but their mutual roommate B is, so A says to B:
  a. Is Moira home?
  b. #Isn't Moira home?
  c. #Is Moira not home?

In the context of (3), a positive polar question like (3a) is perfectly acceptable, while both kinds of negative questions in (3b) and (3c) are unacceptable. We might call this a "neutral context" in the sense that A has no prior expectations about the answer to the polar question, and there is no current contextual evidence supporting one answer or another. Clearly negative questions require a non-neutral context in order to be used. For example, consider the following:

(4) A has just gotten home, and she is expecting Moira to be there. She looks all around the house and can't find her. However, she does find B in the last room that she checks, so she says to B:
   a. Isn't Moira home?
   b. Is Moira not home?

Now, both (4a) and (4b) are acceptable. In fact, many contexts that render high negation questions acceptable also render low negation questions acceptable, and vice versa. However, it turns out that their acceptability depends crucially of different features of the context. In particular, high negation questions necessarily require the speaker to have a prior expectation that the proposition embedded under negation is true, so-called *epistemic bias*. Low negation questions do not have this requirement. To see this, consider the following:

(5) A has no idea whether Moira is home or not, but she has just gotten home and is looking for her. She looks all around the house and can't find her. However, she does find B in the last room that she checks, so she says to B:
   a. #Isn't Moira home?
   b. Is Moira not home?

In this context, the low negation question (5b) is perfectly acceptable, however the high negation question (5a) is not. Here is another example demonstrating the asymmetry:

(6) A has been in a windowless, basement computer lab for the last eight hours. Given her background knowledge, it is equally likely that it could be nice out or not. Then B walks in rubbing her hands together and stamping her feet, and says, "I hate the weather in this town!" A replies:
   a. Is it not nice out?
      $\not\rightsquigarrow$ The speaker believes that it's nice out
   b. #Isn't it nice out?
      $\rightsquigarrow$ The speaker believes that it's nice out

Crucially, high negation questions necessarily convey the speaker's epistemic bias toward the proposition embedded under negation. Thus, if the context establishes that the speaker lacks such a bias, the high negation question will be infelicitous in that context. Note that if we altered (6) slightly so that A has just checked the weather online and has seen that it is supposed to be nice out, now (6b) is a perfectly acceptable response to B's behavior. Low negation questions on the other hand—questions in which the negation is not preposed—are completely acceptable in contexts that lack this epistemic bias.

Such observations are well established in the literature (e.g., Romero and Han, 2004; Sudo, 2013; AnderBois, 2019).[2] Romero and Han further demonstrate that this is not just a quirky fact of English; preposed negation in polar questions correlates with epistemic bias in Modern Greek, Spanish, German, Bulgarian, and Korean, while non-preposed negation does not. The

[2]It is also well established that low negation questions also have distinct licensing requirements, in particular they seem to require immediate contextual evidence in favor of the negative answer, or at least asker interest in the negative answer (Büring and Gunlogson, 2000; Romero and Han, 2004; Sudo, 2013; Trinh, 2014). However this is a distinct phenomenon that is beyond the scope of this paper. See Goodhue (2018b: 85ff) for an argument that high negation questions lack any kind of contextual evidence condition whatsoever, *pace* Büring and Gunlogson (2000); Sudo (2013); Northrup (2014); Trinh (2014).

generalization is also found in Japanese (Ito and Oshima, 2014; Shimoyama et al., 2019), and in Hungarian (Gyuris, 2017).

The crosslinguistic stability of the phenomenon gives rise to the question that motivates this work: Why is there a correlation between negation, preposing, and epistemic bias in polar questions? Since the phenomenon is found in multiple languages, some unrelated to one another, we should expect a deep explanation for this correlation, one that derives epistemic bias from preposed negation, rather than stipulating it.

2.2. High negation vs. verum/polarity focus

Romero and Han (2004) note that both high negation questions and questions with verum/polarity focus convey epistemic bias on the part of the speaker.

(7) a. Isn't Moira home?
$\rightsquigarrow$ The speaker believes that Moira is home
b. IS Moira home?
$\rightsquigarrow$ The speaker believes that Moira is not home

This common meaning leads Romero and Han to propose that high negation is related to verum focus (Höhle, 1992). In particular, they suggest that both high negation as in (7a) and prominence on the auxiliary as in (7b) introduce a VERUM operator to the syntax, which in turn plays a crucial role in the bias derivation. However, they are the first to acknowledge that the link between high negation and VERUM remains an unexplained assumption of their account. And I add that since the account stipulates that high negation introduces VERUM, the crosslinguistic link between high negation and epistemic bias remains unexplained.

An even greater challenge is that a closer examination of high negation and verum/polarity focus in questions reveals two empirical asymmetries that speak against a unified account. First, verum/polarity focus requires the sort of antecedent needed to license prosodic prominence shifts more generally, while high negation does not.

(8) B: Ok, now that Stephan has come, we are all here. Let's go!
A: Wait, Jane's coming too.
B: IS Jane coming?

In (8), B's use of verum/polarity focus is licensed by A's utterance, which provides the required antecedent for the prominence shift. Consider (9), in which the antecedent is missing from the context:

(9) A: Ok, now that Stephan has come, we are all here. Let's go!
a. B: # IS Jane coming?
b. B: Is JANE coming?
c. B: Isn't JANE coming? (Romero and Han, 2004: 610)
d. B: # ISN'T Jane coming?

In this context, verum/polarity focus in (9a) is infelicitous. However, the same question without this prominence shift in (9b) is felicitous. Moreover, note that the high negation question in (9c) is felicitous in this context, despite that the antecedent required for verum/polarity focus is missing. Finally, if we try to shift prominence to the auxiliary as in (9d), the result is infelicitous.

If we thought that high negation was verum focus, then we should expect high negation questions to have the same licensing requirements, but this isn't what we have found, since high negation is acceptable even when verum/polarity focus is not ((9a) vs. (9c)). Minimally, a unified VERUM theory of the two phenomena needs to make the auxiliary assumption that verum/polarity focus has extra licensing requirements above and beyond those that exist for use of the VERUM operator. I think a more straightforward explanation of the facts is to treat verum/polarity focus and high negation as two distinct phenomena requiring distinct accounts.

The second asymmetry between high negation questions and verum/polarity focus questions is that the epistemic bias arising from the former is context insensitive, while that associated with the latter is context sensitive.

(10) B wants to know whether Jill will be at a meeting for members of a club. But B lacks an opinion about whether Jill is a member.
B: Will Jill be at the meeting?
A: If she's a member, she will.
a. B: IS she a member?
$\not\rightsquigarrow$ B believes she isn't a member
b. B: # ISN'T she a member?
$\rightsquigarrow$ B believes she is a member

The context of (10) stipulates that B lacks an epistemic bias about whether Jill is a member. Nevertheless, the verum/polarity focus question in (10a) is perfectly felicitous, despite this lack of bias. The high negation question in (10b) on the other hand is infelicitous in this context. Intuitively, this is because it conveys that B is biased toward the positive answer despite that the context stipulates her lack of bias. Without this contextual stipulation, the high negation question would be perfectly felicitous. If both of these question types introduce a VERUM operator that triggers epistemic bias, as Romero and Han (2004) claim, then this asymmetry is unexpected.

I believe that it is one of the central empirical facts about high negation questions that they always convey a bias, as argued convincingly by Romero and Han. It is an equally central fact about verum/polarity focus questions that the bias they convey is context sensitive. I develop an account of this context sensitive bias in Goodhue (2018a, b). An account of bias in high negation questions will be offered below (based on Goodhue, 2018b).

Due to these empirical asymmetries, I take it that high negation and verum/polarity focus are distinct phenomena deserving distinct theoretical accounts. This frees us up to pursue an account of high negation questions that offers an explanation for the crosslinguistic correspondence between structural height, negation, and bias.

3. Evidence that high negation questions lack propositional negation

We want to know what negation is doing in high negation questions such that it gives rise to epistemic bias. In assertions of declaratives, the effect of negation is straightforward to observe, it reverses truth values. Since polar questions do not have truth values, it is less straightforward to determine the effect of negation. Does the negative morpheme *not/n't* make its usual contribution to the larger composed meaning? Or does it do something else?

Ladd (1981) suggests that high negation questions are ambiguous between an inside negation reading (in which propositional, sentential negation is present), and an outside negation reading, in which negation "is somehow outside the proposition…" If the latter is true, then the interesting question to ask is, where is it? But before we get there, we'd like some empirical evidence of the presence or absence of propositional negation in negative polar questions.

Ladd uses the negative polarity item *either* and the positive polarity item *too* to bring out the two readings.

(11) a. Isn't Jane coming too? — outside negation
b. Isn't Jane coming either? — inside negation

Ladd claims that (11a) questions p, while (11b) questions $\neg p$. However many speakers of American English find (11b) to be infelicitous or at least degraded (cf. AnderBois, 2019), a fact that has been demonstrated experimentally (Hartung, 2006; Sailor, 2013). To make matters worse, it is not completely clear how *either* is licensed (Rullmann, 2003; Ahn, 2015).

The upshot is that we need to look beyond *either* to determine whether high negation questions have a reading with propositional negation. I will do this by considering three phenomena that are sensitive to negation: projecting content, sensitivity to aspect, and polarity particle responses.

3.1. Projecting content

Not-at-issue content (presuppositions and conventional implicatures) projects out of questions. The word *again* presupposes that the proposition denoted by its complement has happened before (see e.g., von Stechow, 1996; Pedersen, 2015). For example:

(12) Did Danielle come to class again?
presupposes: Danielle has come to class before

If again's complement contains negation, then negation should be part of the presupposition. For example:

(13) Did Danielle not come to class again?
presupposes: Danielle did not come to class at least once before.

This is indeed what we find with a low negation question like (13).[3]

Now consider *again* in a high negation question:

(14) Didn't Danielle come to class again?
presupposes: Danielle has come to class before.

Interestingly, the high negation question in (14) does not presuppose the negative proposition that (13) can presuppose. Instead it patterns with (12), presupposing *that Danielle has come to*

[3](13) has another reading in which the presupposition is that Danielle came to class before, which we can safely ignore here. The key fact is that it is able to presuppose the negative proposition.

class before. This pattern replicates with other presupposition triggers.

As-parentheticals provide another test involving non-at-issue content projecting out of questions, this time conventional implicatures. The content of the claim in the *as*-parenthetical in (15) could either include or exclude negation (Potts, 2002).

(15) Kim did not lie, as Ann claimed.
can implicate: Ann claimed that Kim did not lie
or
can implicate: Ann claimed that Kim lied

As above, we can check to see what content projects out of low negation questions and high negation questions:

(16) Did Zoe not win, as Joy predicted?
can implicate: Joy predicted that Zoe did not win
or
can implicate: Joy predicted that Zoe won

(17) Didn't Zoe win, as Joy predicted?
implicates: Joy predicted that Zoe won
but
cannot implicate: Joy predicted that Zoe did not win

Again, we find that the projected content can contain negation in a low negation question, but not a high negation question. These facts suggest that *again* and *as*-parentheticals cannot scope over high negation.

3.2. Negation sensitivity

Until- and *for*-adverbials only combine with clauses that have durative rather than punctual aspect (de Swart, 1996):

(18) Punctual aspect:
a. #Liv discovered the thief until 9.
b. #The ball hit the ground for two minutes.

Negating a verb with punctual aspect creates durative aspect:

(19) Durative aspect:
a. Liv didn't discover the thief until 9.
b. The ball didn't hit the ground for two minutes.

Turning to negative questions, low negation questions license *until-* and *for*-adverbials:

(20) a. Did Liv not discover the thief until 9?
b. Did the ball not hit the ground for two minutes?

However, high negation questions do not:

(21) a. #Didn't Liv discover the thief until 9?
b. #Didn't the ball hit the ground for two minutes?

These facts again suggest that *until*- and *for*-adverbials cannot scope above high negation.

3.3. Inversion is not enough

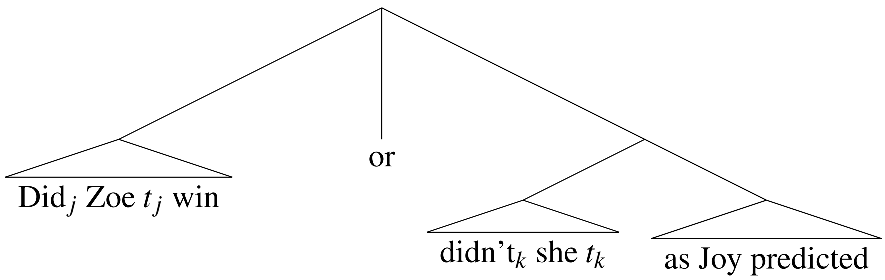
The empirical facts examined so far can be summarized as follows: The relevant operators—*again*, *as*-parentheticals, *until*- and *for*-adverbials—cannot scope above negation in high negation questions. Ultimately, I will claim that this is because high negation does not modify the prejacent of the question, and is instead above a speech act operator, putting it well out of reach of the relevant operators. However, it is worth asking if these scope observations are simply due to the fact that the negative morpheme *n't* inverts with the auxiliary. That is, perhaps the landing site of an inverted auxiliary is too high for *again* and the other operators to reach, and no speech act operator is needed to explain the facts about high negation questions.

To test this idea, we can look at other examples of inversion of *aux-n't* to see whether they behave like high negation questions. Here is an example with an *as*-parenthetical:

(22) Did Zoe win or didn't she, as Joy predicted?
implicates: Joy predicted that Zoe didn't win

Unlike in high negation questions, the *as*-parenthetical scopes over negation in (22), suggesting a structure like (23):

(23)

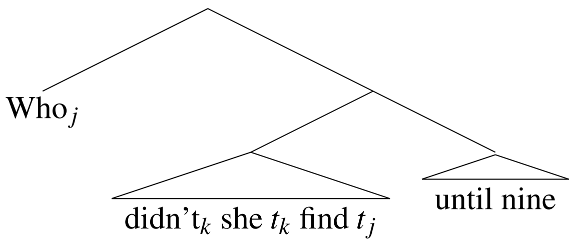


Here is an example with *until*:

(24) *A game of hide-and-seek*
A: Liv found most of them quickly, but she didn't find some of them until nine.
B: Who didn't she find until nine?

Unlike in high negation questions, the *until*-phrase scopes over negation in (24), suggesting a structure like (25):

(25)



I take these results to demonstrate that we are safe in assuming that the high negation question data considered so far are not simply due to the inversion of *aux-n't* in high negation questions. Something different seems to be going on in high negation questions than in other sentences in which *aux-n't* is inverted.

3.4. Responses to negative sentences

As has been explored in recent work (Kramer and Rawlins, 2009; Krifka, 2013; Roelofsen and Farkas, 2015; Holmberg, 2016; Goodhue and Wagner, 2018), negative polar questions have a noteworthy effect on English polar particle responses. While *yes/no* responses to positive polar questions as in (26) convey unambiguous, clear answers, they are interchangeable in response to low negation questions, as in (27).

(26) A: Is Jane here?
- a. B: Yes
  - (i) *can mean*: She is here
  - (ii) *cannot mean*: She is not here
- b. B: No
  - (i) *cannot mean*: She is here
  - (ii) *can mean*: She is not here

(27) A: Is Jane not here?
- a. B: Yes
  - (i) *can mean*: She is here
  - (ii) *can mean*: She is not here
- b. B: No
  - (i) *can mean*: She is here
  - (ii) *can mean*: She is not here

Accounts of these facts in the work cited above differ in interesting ways that are explored in detail in Goodhue and Wagner (2018). However, while the accounts may differ, all researchers agree that a crucial component of the explanation for the contrast between (26) and (27) is that the sentence that B responds to in (27) is negative, i.e., it contains propositional negation, while that in (26) is not.

Krifka (2017) points out that responses to high negation questions pattern with (26) rather than (27):

(28) A: Isn't Jane here?
- a. B: Yes
  - (i) *can mean*: She is here
  - (ii) *cannot mean*: She is not here
- b. B: No
  - (i) *cannot mean*: She is here
  - (ii) *can mean*: She is not here

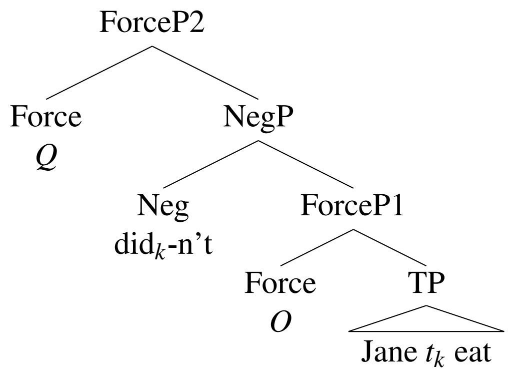
Again, the high negation question patterns with the positive polar question rather than the low negation question. Whatever the negative morpheme in the high negation question is doing, it clearly is not contributing the propositional negation necessary to condition the interchangeable behavior of *yes* and *no* seen in (27).

4. Epistemic operators and unbalanced partitions

The facts presented in section 3 suggest that high negation is indeed outside of the proposition. But where? One likely candidate, the one I will pursue here, is that high negation is located above an operator *O* that, broadly speaking, contributes some epistemic, doxastic, or commitment-based meaning to the interpretation. The advantage of this approach is that it provides a ready made explanation for the facts from the previous section if the relevant phrases naturally cannot scope above *O*. Moreover, I will argue it has a second advantage in that it provides a necessary piece of the puzzle for explaining the crosslinguistic correlation between negation, structural height, and bias.

The idea that high negation scopes above an epistemic, conversational operator is suggested already by Romero and Han (2004) in the form of their VERUM operator. A substantively different take on the same basic idea is put forth by Krifka (2017), who argues that high negation scopes above an *ASSERT* speech act operator, defined in terms of a commitment space semantics. I will explore here the idea that negation scopes above a doxastic speech act operator. Such operators have been proposed for independent reasons in the prior literature (Kratzer and Shimoyama, 2002; Chierchia, 2006; Alonso-Ovalle and Menéndez-Benito, 2010; Meyer, 2013). Here is the structure I assume for a high negation question like "Didn't Jane eat?" (cf. Krifka 2017, who proposes a similar structure):

(29)



Besides having the advantage of explaining the facts from section 3, the account also puts flesh on the bones of Ladd's suggestion that high negation is outside of the proposition. Moreover, negation is still negation, so if this idea can be shown to play a key role in the derivation of bias, then we would have an explanation for the persistent crosslinguistic link between negation, structural height, and bias. In the next section, I will argue that it does indeed play just such a key role in the bias derivation.

First however, an interpretation for the structure in (29) is needed. I will assume that *O* has the denotation of a doxastic necessity operator, as in (30).

(30) $[\![O]\!] = \lambda p_{\langle s,t\rangle}.\lambda w_s.\forall w' \in Dox_x(w)[p(w') = 1]$

$Dox_x(w)$ is the set of worlds compatible with x's beliefs in w. x is a free variable for individuals whose value is contextually determined. When *O* appears in (falling) declaratives, x is the speaker, but in high negation questions, x is the addressee. In the following, I will frequently abbreviate doxastic necessity with "$\Box$" for ease of exposition.[4]

Following Romero and Han (2004), and Dayal (2016), I assume the denotation for *Q* in (31), which provides Hamblin (1973)/Karttunen (1977) denotations for polar questions.[5]

[4]So, if $[\![\phi]\!] = p$ (where p is a proposition), then $[\![O\phi]\!] = \Box p$, and $[\![[not[O\phi]]]\!] = \neg\Box p$.

[5]I assume that the auxiliary *did* is vacuous, and that *not/n't* is defined for propositions: $[\![\text{not/n't}]\!] =$

(31) $[\![Q]\!] = \lambda p_{\langle s,t\rangle}.\lambda q_{\langle s,t\rangle}.[q = p \vee q = [\![not]\!](p)]$

The interpretation for the LF in (29) is worked out in (32).

(32) a. $[\![\text{TP}]\!] = \lambda w_s.\ \text{eat}(j)(w)$

b. $[\![\text{ForceP1}]\!] = [\![O]\!](\lambda w_s.\ \text{eat}(j)(w)) =$
$\lambda p_{\langle s,t\rangle}.\lambda w_s.\forall w' \in Dox_x(w)[p(w') = 1](\lambda w_s.\ \text{eat}(j)(w)) =$
$\lambda w_s.\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1]$

c. $[\![\text{NegP}]\!] = [\![\text{did}_k\text{-n't}]\!](\lambda w_s.\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1]) =$
$\lambda p_{\langle s,t\rangle}.\lambda w_s.\neg p(w)(\lambda w_s.\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1]) =$
$\lambda w_s.\neg\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1]$

d. $[\![\text{ForceP2}]\!] = [\![Q]\!](\lambda w_s.\neg\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1]) =$
$\lambda p_{\langle s,t\rangle}.\lambda q_{\langle s,t\rangle}.[q = p \vee q = [\![not]\!](p)](\lambda w_s.\neg\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1]) =$
$\lambda q_{\langle s,t\rangle}.\ [q = \lambda w_s.\neg\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1]$
$\vee\ q = \lambda w_s.\neg\neg\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1] =$
$\lambda q_{\langle s,t\rangle}.\ [q = \lambda w_s.\neg\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1]$
$\vee\ q = \lambda w_s.\forall w' \in Dox_x(w)[\text{eat}(j)(w') = 1] =$
$\{\neg\Box$ *that Jane ate*, $\Box$ *that Jane ate*$\}$

The denotation for high negation questions produced in (32) is similar to that proposed by Romero and Han, except with VERUM replaced by doxastic necessity, and the assumption based on data from section 3 that a high negation question like "Didn't Jane eat?" only corresponds to the LF in (29), and is not ambiguous between (29) and another structure in which negation scopes below O. That is, high negation questions only have the structure $[Q[NEG[O[\phi]]]]$, not $[Q[O[NEG[\phi]]]]$.

As Romero and Han note, if we think of the resulting set of propositions as a partition in Groenendijk and Stokhof's (1984) sense, then the partition is unbalanced. Whereas a positive polar question presents a balanced partition between p and $\neg p$, a high negation question presents an unbalanced partition in which the addressee is presented with the choice between doxastic necessity for p, or a lack of doxastic necessity for p. Krifka (2017) refers to the latter option as one in which the addressee refrains from committing to p. Romero and Han say that it covers any other degree of belief in p besides belief in p itself. I will ultimately argue that the bias of high negation questions follows from the way in which the possibility space is unbalanced, with the speaker expressing bias for the more precise, more narrowly defined cell, $\Box p$. Despite that both Romero and Han, and Krifka posit such unbalanced partitions, neither derives the bias associated with high negation questions from the way in which the partition is unbalanced.

As Meyer (2013) points out, $\neg\Box p$ would be a weak claim, since it includes a wide range of situations, which can be partitioned into two sorts.

1. Lack of belief either way: the addressee neither believes p, nor $\neg p$ $(\neg\Box p \wedge \neg\Box\neg p)$
2. The addressee believes $\neg p$ $(\Box\neg p)$

As I will show in section 5, the direction in which the partition is unbalanced plays a key role in the kind of bias a high negation question conveys.

$\lambda p_{\langle s,t\rangle}.\lambda w_s.\neg p(w)$. Set-theoretically, negation returns the complement of the set of worlds representing the input proposition p, $W \setminus p$.

5. Deriving epistemic bias

In a nutshell, the bias derivation proceeds as follows: First, I will assume that questions are felicitous only if they are useful. Second, I will argue that high negations questions are useful only if the speaker is biased toward the prejacent of the question. Equivalently, I will argue that if the speaker is not biased toward the prejacent, then some other question will be more useful. This argument depends on the way in which high negation question partitions are unbalanced. When the speaker is not biased for p, the problem will be that the less specific cell of the partition ($\neg\Box p$) won't provide useful information to the speaker, or at least, not as much useful information as a different partition could produce. In other words then, we can compare the utility of competing question partitions, and what we will find is that the high negation question partition is only useful when the speaker is biased.

To begin, let's recast the goal of the derivation as a felicity condition on the use of high negation questions. "HNQ-p" is shorthand for a high negation question with propositional content p. The propositional content is the denotation of the TP, so for example, the propositional content of "Didn't Jane eat?" is the proposition *that Jane ate*.

(33) *HNQ bias*:
HNQ-p is felicitous only if the speaker S is biased for p

The goal then is to derive (33) from the unbalanced partition of high negation questions and general pragmatic principles.

The derivation will depend in part on the relative utility of different questions given the speaker's goals (cf. Van Rooy and Šafářová, 2003). I assume the following condition on the felicitous use of questions:

(34) *Question utility*:
A question Q is felicitous only if Q is at least as useful as other questions Q'

Obviously, much depends on how the phrase "at least as useful as" in (34) is understood. The guiding idea: the utility of one question can be compared to that of another by considering the partitions denoted by the questions, and asking which partition's cells would increase the speaker's information more, given the speaker's goals. Crucially, the speaker's goals may be different in different contexts, which will affect how cells impact the speaker's information. In the following, we will need to consider carefully just two sorts of contexts: contexts in which the speaker wants to gain information about p from the addressee, and contexts in which the speaker wants to determine agreement over p with the addressee.

To see why these two sorts of contexts matter, we need to consider the second main step of the bias derivation, which for lack of a better term, I simply refer to as *the lemma*:

(35) *The lemma*:
HNQ-p is at least as useful as other Qs only if S is biased for p.

The lemma in (35) is phrased as is because it provides a crucial intermediate step from (34) to (33), the goal of the bias derivation. Together (35) and (34) entail (33):

(36) (34) *Q Utility*: A question Q is felicitous only if Q is at least as useful as other Qs.
(35) *The lemma*: HNQ-p is at least as useful as other Qs only if S is biased for p.
$\therefore$ (33) *HNQ bias*: HNQ-p is felicitous only if S is biased for p.

To see that (35) holds, it is helpful to restate it in the form of its contrapositive:

(37) *Contrapositive of (35)*:
If S is not biased for p, then some other Q is more useful than HNQ-p.

To show that (37) holds, we need to say what it means for S to be biased for p. I take bias to be identical to the doxastic necessity operator introduced in (30). S is biased for p if and only if S believes p, i.e., p holds throughout the worlds compatible with her beliefs.[6] Therefore, in order to show that (37) holds, we need to consider situations in which it's not the case that S believes p ($\neg\Box p$), and demonstrate that some other Q is more useful than HNQ-p in each of those situations.

As I said above, $\neg\Box p$ situations can be partitioned into two subkinds of situations:

1. Lack of belief either way: the speaker neither believes p, nor $\neg p$ ($\neg\Box p \wedge \neg\Box\neg p$)
2. The speaker believes $\neg p$ ($\Box\neg p$)

Situation 1 includes a wide array of degrees of belief about p/$\neg p$. S may be leaning toward p, or toward $\neg p$, or completely split between the two, and anything else in between. Nevertheless, this variation is irrelevant to our purposes. Situation 2 is much more narrow, covering only cases in which S is certain that $\neg p$. The goal now is to show that in each of these kinds of situations, some other Q would be more useful than HNQ-p.

5.1. Situation 1: lack of belief either way ($\neg\Box p \wedge \neg\Box\neg p$)

If S lacks belief about p either way (and p is relevant at this point), then her goal will be to gain information about p from her addressee.

(38) *Gain info strategy*:
Q_1 is more useful than Q_2 iff the cells of the partition representing Q_1 produce epistemic states that are more informed relative to p than the cells of Q_2 do.

Given the strategy for comparing the utility of questions in (38), consider the positive polar question in (39):

(39) $[\![$Did Jane eat$]\!]$ = $\{$*that Jane ate, that Jane did not eat*$\}$

Clearly, either of the cells in the partition in (39) would increase S's information, given that she began with a lack of belief either way about p.

Now consider the high negation question in (40):

(40) $[\![$Didn't Jane eat$]\!]$ = $\{\Box$ *that Jane ate*, $\neg\Box$ *that Jane ate*$\}$

The first cell of the partition would certainly increase S's information, since it conveys A's certainty that p. The second cell, however, is not ideal: since $\neg\Box p$ is compatible with A's lack

[6] This claim is discussed further in Goodhue (2018b: 130ff).

of belief about p ($\neg\Box p \wedge \neg\Box\neg p$), S doesn't yet learn much about p from this cell. S learns that it's not the case that A believes p, but since this could be because A lacks a belief either way, S doesn't yet learn whether or not p holds.

Therefore, by (38), the positive polar question in (39) is more useful than HNQ-p in (40) when S lacks a belief either way about p.

5.2. Situation 2: certainty that $\neg p$

If S is biased toward $\neg p$ (and $\neg p$ is relevant at this point), then S's goal will be to determine whether or not she and her addressee agree about $\neg p$.

(41) *Determine agreement strategy*:
Q_1 is more useful than Q_2 iff the cells of the partition representing Q_1 make it easier to determine whether A agrees with S about p than the cells of Q_2 do.

Given the strategy for comparing the utility of questions in (41), consider the high negation question with an added low negation in (42):

(42) $[\![$Didn't Jane not eat$]\!] = \{\Box$ *that Jane did not eat*, $\neg\Box$ *that Jane did not eat*$\}$

Either one of the cells in (42) would enable S to learn whether or not A agrees with her bias for $\neg p$. The first cell ($\Box\neg p$) would clearly indicate agreement. The second cell ($\neg\Box\neg p$) would indicate disagreement since it would mean that A does not hold the same belief as S.

Now consider the high negation question in (43):

(43) $[\![$Didn't Jane eat$]\!] = \{\Box$ *that Jane ate*, $\neg\Box$ *that Jane ate*$\}$

The first cell ($\Box p$) could be used to convey that A definitely disagrees with S, since it's the opposite belief about p. The second cell ($\neg\Box p$), however, would leave S uncertain as to whether they agree, since it is consistent with both $\Box\neg p$, which would mean A and S agree, and lack of belief ($\neg\Box p \wedge \neg\Box\neg p$), which would indicate disagreement.

Therefore, by (41), the high negation question with an added low negation in (42) is more useful than HNQ-p in (43) when S is biased for $\neg p$.

5.3. Putting it together

Recall the contrapositive of the lemma that we set out to prove:

(37) *Contrapositive of (35)*:
If S is not biased for p, then some other Q is more useful than HNQ-p.

I pointed out that the antecedent, *S is not biased for p*, is consistent with exactly two states of affairs, lack of bias either way ($\neg\Box p \wedge \neg\Box\neg p$), and bias for $\neg p$ ($\Box\neg p$). In section 5.1 and section 5.2, I argued that in each of these states of affairs some other question is more useful than HNQ-p. Therefore, (37) holds, which means the lemma itself in (35) holds.

The lemma together with question utility in (34) entails the bias condition on high negation questions in (33).

(36) (34) *Q Utility*: A question Q is felicitous only if Q is at least as useful as other Qs.
(35) *The lemma*: HNQ-p is at least as useful as other Qs only if S is biased for p.
$\therefore$ (33) *HNQ bias*: HNQ-p is felicitous only if S is biased for p.

The bias of high negation questions falls out from the fact that the unbalanced partition of HNQ-p is not useful when the speaker is not biased for p. Instead, other questions are more useful. We conclude that the only kind of context in which HNQ-p could be useful is one in which S is biased for p.

6. Conclusion

I have argued that the crosslinguistic correspondence between negation, preposing, and bias in polar questions observed by Romero and Han (2004) requires an explanation: why does preposing negation necessarily give rise to a bias inference? Given the crosslinguistic persistence of the signal, we should expect the meaning of negation to play a role.

In section 3, I demonstrated that high negation is not in the propositional core of the question. Therefore, we should also expect the structural height of negation to play a key role in the presence of bias. Given these facts, I argued that high negation is above a syntactically represented doxastic operator O, and showed how such a structure gives rise to an unbalanced partition for high negation questions (section 4).

Then in section 5, I argued that such unbalanced partitions require the speaker to be biased for the propositional prejacent of the high negation question. This is because if the speaker were not biased for p, other questions would be more useful.

The advantage of this account is that it explains the crosslinguistic connection between negation, height, and bias. The high position for negation gives the question a unique interpretation. That unique interpretation in turn is only useful if the speaker is biased in a certain way. As mentioned above, the idea that high negation questions involve a kind of assertion or epistemic/doxastic operator that negation can scope above is not novel. What is novel is some of the evidence that high negation does indeed scope above such an operator, the evidence that the operator is unlikely to be related to verum/polarity focus, and the argument that bias falls out of the interpretation of such structures. Since the semantics flows from the syntax, the arguments presented here provide an explanation for the crosslinguistic link between high negation and bias.

In the future, more work is needed on high negation is languages other than English, especially unrelated languages. Japanese provides one interesting avenue for further research (Ito and Oshima, 2014; Shimoyama et al., 2019).

I consider the precise characterization of the semantics of the operator O an open question. I treated it as doxastic necessity in section 4, however this is not necessary. If the goal is simply to explain the bias inference, then other epistemic, doxastic or conversational operators would do. For example, the bias derivation could be given using Krifka's (2017) commitment based semantics, as is done in Goodhue (2018b). It could also be given using Romero and Han's (2004) VERUM operator, so long as its syntax is constrained so that high negation may only scope above it. Moreover, the operator could be weakened by giving it a semantics similar to a weak epistemic *must* (e.g. Kratzer, 1991; Lassiter, 2016). If it were decided that the bias associated with high negation questions is weaker than outright belief, such a weakening of *O*'s semantics would ensure that the bias derivation given in section 5 would still go through. I leave an adjudication between competing options for the precise characterization of *O*'s semantics to future work.

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A case for no Ks

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Abstract. We present a novel observation about modified numerals and discuss how it may pose a problem for the syntactic representation of speaker's belief, hence the grammatical derivation of ignorance inferences.

Keywords: numeral, exhaustification, implicature, ignorance

1. Two ways of deriving the ignorance inference of "at least"

It has been observed that the modifier *at least* gives rise to "ignorance inferences." For example, (1) implies that the speaker is not sure whether there are exactly two students (Geurts and Nouwen, 2007; Buring, 2008; Schwarz, 2016).[1]

(1) there are at least two students in the classroom
$\rightsquigarrow$ $\neg K(\textit{exactly two}) \wedge \neg K \neg(\textit{exactly two})$
"the speaker is not sure whether there are exactly two students in the classroom"

This inference can be explained in terms of "exhaustification." One implementation of this explanation assumes (2), where the silent operator exh_A is defined as in (3) (cf. Fox, 2007a, b; Chierchia et al., 2012).

(2) Syntactic assumption
Every sentence ϕ can be parsed as $exh_A\ \phi$

(3) Definitions
a. $exh_A\ \phi \Leftrightarrow \phi \wedge \bigwedge\{\neg\psi : \psi \in IE(\phi, A)\}$
"$exh_A\ \phi$ is true iff ϕ is true and every ψ which is innocently excludable given ϕ and A is false"
b. $\psi \in IE(\phi, A)$ iff $\psi \in \bigcap \{A' \mid A'$ is a maximal subset of A s.t. $\{\phi\} \cup \{\neg\phi' \mid \phi' \in A'\}$ is consistent$\}$
"ψ is innocently excludable given ϕ and A iff ψ is a member of A and $\phi \wedge \neg\psi$ does not entail any disjunction of members of A not entailed by ϕ"

The idea is that by uttering ϕ, the speaker is actually saying $exh_A\ \phi$, which settles not just ϕ but also certain members of the set A, i.e. the set of "alternatives" of ϕ.[2] For present purposes, we need not go into details of how A is determined. It suffices to note a fact about A which, to the best of our knowledge, underlies every conception of this set which has been proposed in the literature. It is this.

(4) Fact about A
If $exh_A\ \phi$ is relevant, every member of A is relevant

From the Gricean maxims of Quality, Quantity, and Relation, it follows that what a speaker says is relevant and settles all relevant propositions he is not ignorant about about (cf. Grice,

[1] We will write "$K\phi$" to represent the fact that ϕ is entailed by the speaker's belief, which means the speaker's ignorance about ϕ can be represented as "$\neg K\phi \wedge \neg K \neg\phi$."
[2] A sentence ϕ settles another sentence ψ iff ϕ either entails ψ or entails $\neg\psi$.

Proceedings of Sinn und Bedeutung 23, vol. 1, pp. 487–494. Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès).

1967). Given (4), this means the following (Kroch, 1972; Fox, 2007a, b; Chierchia et al., 2012).

(5) Fact about $exh_A\ \phi$
The speaker of $exh_A\ \phi$ is ignorant about members of A which are not settled by $exh_A\ \phi$

Let us look at an example. Suppose someone utters "John talked to Mary or Sue." By virtue of (2), what he is saying is not the simple disjunction $m \vee s$, but its exhaustification $exh_A(m \vee s)$. Under the assumption that A, in this case, is the set in (6a) (cf. Sauerland, 2004), we derive (6b) and (6c).

(6) $exh_A(m \vee s)$ 'John talked to Mary or Sue'
a. $A = \{m \vee s, m, s, m \wedge s\}$
b. $exh_A(m \vee s) \Leftrightarrow (m \vee s) \wedge \neg(m \wedge s)$
c. $exh_A(m \vee s) \rightsquigarrow \neg Km \wedge \neg K\neg m \wedge \neg Ks \wedge \neg K\neg s$

The equivalence in (6b) follows from (3): $exh_A(m \vee s)$ entails $(m \vee s)$ because $(m \vee s)$ is the sister of exh_A, and entails $\neg(m \wedge s)$ because $(m \wedge s)$ is innocently excludable given $(m \vee s)$ and A. The other two members of A, m and s, are not settled by $exh_A(m \vee s)$. From (5), then, we derive (6c). Thus, we expect the speaker who utters "John talked to Mary or Sue" to be saying that John did not talk to both Mary and Sue, and to be ignorant, i.e. unsure, about whether John talked to Mary as well as about whether John talked to Sue. It is generally agreed that this aligns with the attested intuition.

A crucial ingredient in the account, obviously, is (6a). Predictions about what inferences a sentence licenses vary according to what its alternatives are assumed to be and can, therefore, be used to measure the success of theories on alternatives. Coming back to the case of modified numerals, we will assume, for present purposes, that (7) holds, i.e. that alternatives of (8a) are (8b) and (8c), which are generated by replacing *at least* with *exactly* and *more than* (cf. Kennedy, 2015; Buccola and Haida, 2018).

(7) Scale mates of *at least n*
at least n alternates with *exactly n* and *more than n*

(8) a. there are at least two student in the classroom
b. there are exactly two students in the classroom
c. there are more than two students in the classroom

We are now in the position to account for the ignorance inference licensed by (8a) which is discussed at the beginning of this paper. In fact, there are two ways to derive this inference. One, call it the "pragmatic" derivation, proceeds as follows. By virtue of (2), the speaker who utters (8a) is saying (9a). Given (7), the set of alternatives is (9b). Given (3), $exh_A(\textit{at least two})$ settles neither *exactly two* nor *more than two*. It then follows, from (5), that the speaker who utters (8a), thereby saying (9a), is ignorant about *exactly two* and *more than two*, which means, equivalently, that he is ignorant about *exactly two*. This results aligns with intuition.

(9) a. $exh_A(\textit{at least two})$ 'there are at least two student in the classroom'
b. $A = \{\textit{at least two}, \textit{exactly two}, \textit{more than two}\}$
c. $exh_A(\textit{at least two}) \rightsquigarrow \neg K(\textit{exactly two}) \wedge \neg K\neg(\textit{exactly two})$

Another way to derive the ignorance inference of *at least*, call it the "semantic derivation," proceeds as follows. First, we will assume that the speaker's belief is explicitly represented in the syntax (cf. Meyer, 2014; Buccola and Haida, 2018).

(10) Syntactic assumption
The lexicon contains an operator, K, which means 'the speaker believes that' and which can be appended to every sentence.[3]

This assumption, in conjunction with (2), allows us to postulate (11b) as what is said by the speaker who utters (11a). From (7), it follows that the set of alternatives is (11c). By virtue of (3), both $K(\textit{exactly two})$ and $K(\textit{more than two})$ are innocently excludable. This means that (11b) is equivalent to (11d), which is in turn equivalent to (11e).

(11) a. there are at least two students in the classroom
b. $exh_A(K(\textit{at least two}))$
c. $A = \{K(\textit{at least two}), K(\textit{exactly two}), K(\textit{more than two})\}$
d. $K(\textit{at least two}) \wedge \neg K(\textit{exactly two}) \wedge \neg K(\textit{more than two})$
e. $K(\textit{at least two}) \wedge \neg K(\textit{exactly two}) \wedge \neg K \neg(\textit{exactly two})$

As we can see, the ignorance inference of *at least*, in the semantic derivation, becomes part of the literal meaning of what is said. In the pragmatic derivation, on the other hand, it arises from (5), which is a consequence of Gricean maxims.

Which derivation is correct? This question, in principle, is an empirical one: there is no a priori reason to assume that linguistic facts do not exist which favor settling it one way or another. We will argue that the contrast in (12) is such a fact.

(12) a. there are at least two students in the classroom
b. *there are at least zero students in the classroom

The numeral *zero* cannot be modified by the adverb *at least*. We will propose an account of this observation which makes a case that speakers' belief is not explicitly represented, i.e. "a case for no *K*s" in the syntax. To the extent that our account is correct, it is the pragmatic derivation of the ignorance inference of *at least* which is correct, as the semantic derivation crucially requires K to be syntactically represented.

The presentation of our account requires laying some groundwork. This task is undertaken in the next section.

2. L-Analyticity and the theory of *zero*

It has been claimed that a sentence can be deviant if it is tautological or contradictory purely by virtue of the configuration of logical constants in it (Barwise and Cooper, 1981; Fintel, 1993; Gajewski, 2003; Chierchia, 2006; Abrusán, 2007; Gajewski, 2009; Abrusán, 2011). As an example, consider the contrast in (13), discussed in Fintel (1993).

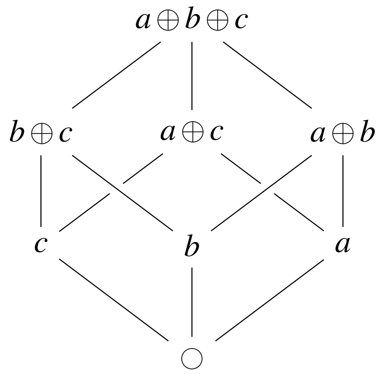
(13) a. everyone but Bill danced
'everyone who is not Bill danced & ¬everyone danced'
b. *someone but Bill danced
'someone who is not Bill danced & ¬someone danced'

[3]For concreteness, let us say that K has the following semantics: $[\![K\ \phi]\!]^w = 1$ iff $[\![\phi]\!]^{w'} = 1$ for every world w' compatible with what the speaker believes in w.

Under the sentences we give very informal paraphrases of von Fintel's semantic analyses which, nevertheless, suffice to show that (13a) is not, while (13b) is, a contradiction. Moreover, any replacement of the non-logical words in (13b), which are *one*, *Bill* and *danced*, would still result in a contradiction. It is in this sense that the sentence is said to be "L-analytical."[4] We will write "$\phi \Leftrightarrow_L \top$" or "$\phi \Leftrightarrow_L \bot$" to say that ϕ is L-analytically tautological or L-analytically contradictory, respectively.

L-analyticity is crucially appealed to by the theory of the numeral *zero* which we will assume here. This is the theory proposed in Bylinina and Nouwen (2018), according to which every plural noun has in its denotation a special element, $\bigcirc$, whose atoms count 0. To illustrate, suppose *a*, *b* and *c* are the only students in the world. The extension of the plural noun *students* would the be set containing all elements in the complete lattice below.

(14) $[\![\text{students}]\!] = \{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c, \bigcirc\}$



The phrase *2 students*, for example, would denote the set of $[\lambda x[x \in [\![\text{students}]\!] \wedge \#x = 2]]$, i.e. the set $\{a \oplus b, b \oplus c, a \oplus c\}$.[5] We will assume that the existential sentence *there are 2 students* amounts to the claim that this set is not empty.

(15) there are 2 students $\Leftrightarrow [\exists x[x \in [\![\text{students}]\!] \wedge \#x = 2]]$

What about sentences with the numeral 0, for example (16)?

(16) there are zero students

Intuitively, (16) is well-formed. Now suppose (16) is parsed as (17), yielding the meaning 'there are zero or more students,' we will have an L-analytical sentence, and thus make the false prediction that (16) is deviant.

(17) $[_S$ there are zero students$]$
$\Leftrightarrow \exists x(\#x = 0 \wedge x \in [\![\text{students}]\!]) \Leftrightarrow_L \top$

However, parsing (16) with exh_A as in (18), yielding the meaning 'there are zero and no more students,' will rescue it from being an L-analytical sentence.[6]

(18) $[_S$ exh_A $[_S$ there are zero students$]]$
$\Leftrightarrow \exists x(\#x = 0 \wedge x \in [\![\text{students}]\!]) \wedge \neg \exists x(\#x > 0 \wedge x \in [\![\text{students}]\!]) \not\Leftrightarrow_L \top$

[4]This is also a simplification. For the full-fledged definition of L-analyticity, see Gajewski (2003, 2009).
[5]The measure function # maps an individual to its atom count, i.e. the number of atoms it contains.
[6]We assume that **zero** is a numeral and thus alternates with other numerals.

Consequently, *zero* always means 'zero and no more.' See Bylinina and Nouwen (2018) for arguments that this is in fact the case.

3. Settling the issue

Let us now come back to the novel observation mentioned at the end of section 1, namely that *zero* cannot be modified by *at least*.

(19) a. there are at least two students in the classroom
b. *there are at least zero students in the classroom

To give empirical support to our factual claim, we conducted an experiment on Amazon MTurk, whose results are shown in the figures below.

Figure 1: Boxplot of *at least 2* and *at least 0*

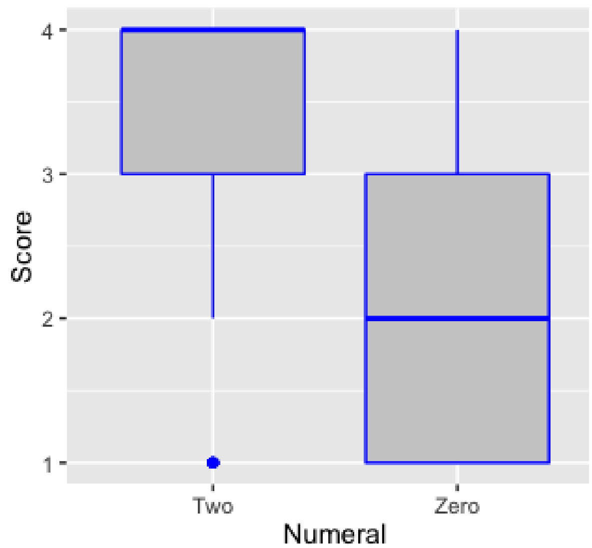
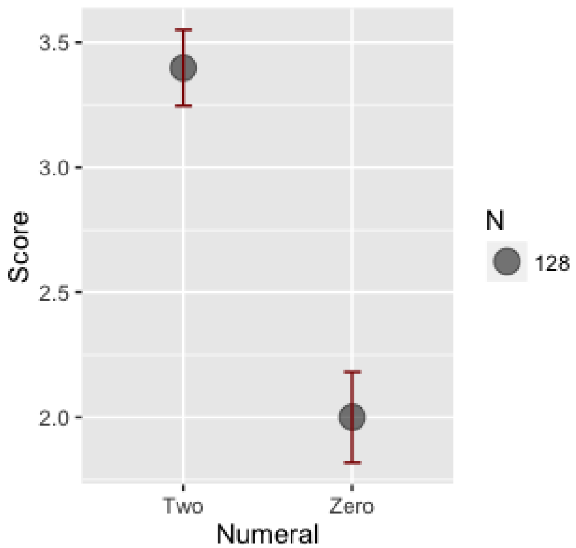


Figure 2: Means of *at least 2* and *at least 0*



As we can see, sentences with *at least two* receive a much higher score, i.e. are much more acceptable, than those containing *at least zero*.

We are now in the position to settle the question which of the two derivations of the ignorance inference of *at least* is correct. Recall that the semantic derivation crucially depends on the assumption that K, the operator representing speaker's belief, is explicitly represented. Suppose, then, that this is the case, i.e. that K is explicitly represented. The sentence **there are at least zero students* will then have (20) as a possible parse.

(20) $exh_A(K(\text{there are at least zero students in the classroom}))$

Given that *at least* alternate with *exactly* and *more than*, the set of alternative A would contain (21a) and (21b).

(21) a. $K(\text{there are exactly zero students in the classroom})$
b. $K(\text{there are more than zero students in the classroom})$

This means that (20) is not analytical, hence not L-analytical, as it means (22), which is true iff the speaker's belief contains worlds where there are no students in the classroom and worlds where there are some students in the classroom, i.e. iff the speaker doesn't know whether there are any students in the classroom at all.

(22) K(there are at least zero students in the classroom) $\wedge \neg K$(there are exactly zero students in the classroom) $\wedge \neg K$(there are more than zero students in the classroom)

Now suppose K is not syntactically represented. Then, **there are at least zero students in the classroom* has (23) as available parse.

(23) exh_A(there are at least zero students in the classroom).

In this case, the set of alternatives A would contain (24a) and (24b), none of which is innocently excludable.

(24) a. there are exactly zero students in the classroom
b. there are more than zero students in the classroom

This means that (23) is analytical. Furthermore, it is L-analytical, assuming that *at least* is a logical term, i.e. one whose meaning is invariant across possible worlds. In fact, (23) ends up having the same meaning which *there are zero students* would have if it is not exhaustified: the adverb *at least* makes exhaustification vacuous.

We have considered two options: (i) K is explicitly represented in the syntax, and (ii) K is not so represented. We have seen that the first option predicts **there are at least zero students in the classroom* to have a parse which is not L-analytical, while the second option predicts this sentence to be L-analytical. Given that the sentence is perceived to be deviant, we have an argument for the second option and against the first. Since the semantic derivation of the ignorance of *at least* presupposes that the first option is available, we have an argument that that derivation is wrong, hence that the pragmatic derivation is correct.

4. Residual issues

4.1. A prediction

We predict that the *meaning* of (19b) can be felicitously expressed by a non-L-analytical sentence, such as (25a), whose LF is (25b) (Hurford, 1974; Chierchia et al., 2012; Fox and Spector, 2018).

(25) a. there are zero or more students
b. exh_A(there are zero students) or (there are more than zero students)

A Google search of, e.g., the phrase **0 or more times** gives $170,000$ results, while **at least 0 times** only gives $2,780$ results.

4.2. Two-sided meaning for numerals

One argument that **zero** is a numeral, not a quantifier, is that it is neither downward entailing nor does it have the distribution of a generalized quantifier (Nouwen & Bylinina's 2017):

(26) a. no/*zero students said anything
b. the number of students in the classroom is zero/*no

Suppose numerals have a two-sided meaning as a matter of semantic content, as proposed by several works (Breheny, 2008; Geurts, 2006; Kennedy, 2015). We will correctly derive that *there are zero students* is non-tautological, and that *there are at least zero students* is L-tautological.

(27) a. there are zero students $\Leftrightarrow$ exh_C(there are zero students)
$\Leftrightarrow \max\{n \mid \exists x[x \in [\![\text{students}]\!] \wedge \#x = n]\} = 0$
$\Leftrightarrow$ exh_C [there are at least 0 students] $\not\Leftrightarrow \top$ (where, like before, $\bigcirc \in [\![\text{students}]\!]$ and $\#\bigcirc = 0$)

b. there are at least 0 students $\Leftrightarrow$ exh_C(there are at least 0 students)
$\Leftrightarrow \max\{n \mid \exists x[x \in [\![\text{students}]\!] \wedge \#x = n]\} \geq 0$
$\Leftrightarrow_L \top$

However, we still derive, incorrectly, that the deviance of *at least zero* is obviated under universal quantification:

(28) $\text{exh}_C\,(K(\text{there are at least 0 student}))$

$$\begin{aligned}
&\Leftrightarrow K(\max\{n \mid \exists y[y \in [\![\text{students}]\!] \wedge \#y = n]\} \geq 0]) \\
&\quad \wedge \neg K(\max\{n \mid \exists y[y \in [\![\text{students}]\!] \wedge \#y = n]\} = 0]) \\
&\quad \wedge \neg K(\max\{n \mid \exists y[y \in [\![\text{students}]\!] \wedge \#y = n]\} > 0]) \\
&\not\Leftrightarrow \top
\end{aligned}$$

Thus, assuming the two-sided meaning for numerals will not rescue the semantic derivation of the ignorance inferences of *at least*.

4.3. The logical status of scales

We have given a semantic explanation for the incompatibility of *at least* and *zero*. Our account, thus, would be corroborated by facts which suggest that this incompatibility is not morphological. We believe the following contrast is such a fact.

(29) a. The temperature is at least zero degrees Celsius
b. #The temperature is at least zero degrees Kelvin

The contrast shows that it is not the morphological word *zero* which resists combination with *at least*, but the meaning of this word: *zero* in *zero degrees Celsius* does not denote the lowest point of the scale, hence does not really mean 'zero.' This is different with *zero* in *zero degrees Kelvin*, which denotes absolute zero and hence the lowest point of the relevant scale.

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How to point at discourse referents: On anaphoric uses of complex demonstratives[1]

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Abstract. The topic of this paper is an unexpected contrast between complex demonstratives and definite descriptions on their respective anaphoric or bound uses: While it is entirely natural to pick up two discourse referents introduced by indefinites in the preceding sentence via definite descriptions, picking them up via complex demonstratives leads to infelicity. If only one of the two discourse referents is picked up by a complex demonstrative, while the other is either not picked up at all, or by a definite description, in contrast, the resulting mini-text is again felicitous. Finally, two complex demonstratives can co-occur in a sentence if their use is accompanied by a pointing gesture in the direction of a perceptually salient individual. I will show that this pattern can be accounted for if complex demonstratives not only on their deictic, but also on their anaphoric or bound uses are assumed to be accompanied by (abstract or concrete) demonstrations (Bühler, 1934; Roberts, 2002) that may not have overlapping trajectories.

Keywords: demonstratives, definite descriptions, co-reference, binding, pointing.

1. Introduction

The topic of this paper is an unexpected contrast between complex demonstratives and definite descriptions on their respective anaphoric or bound uses: While it is entirely natural to pick up two discourse referents introduced by indefinites in the preceding sentence via definite descriptions ((1a)), picking them up via complex demonstratives leads to infelicity ((1b) and (1c)). If only one of the two discourse referents is picked up by a complex demonstrative, while the other is either not picked up at all ((2a) and (2b)), or by a definite description ((2c) and (2d)), in contrast, the resulting text segment is again felicitous. Finally, consider the sentences in (3a) and (3b), where the use of the respective complex demonstrative is accompanied by a pointing gesture in the direction of a perceptually salient individual. The felicity of both (3a) and (3b) shows that the infelicity of (1b) and (1c) is neither due to a general constraint against the occurrence of more than one demonstrative in a sentence, nor a constraint that prevents demonstratives with contrasting NPs from co-occurring. Note that capitals indicate focal stress.

(1) a. Last night, a dog chased a cat in front of my house. Fortunately, [the CAT] was pretty fast, while [the DOG] was rather slow.
b. Last night, a dog chased a cat in front of my house. ??Fortunately, [that CAT] was pretty fast, while [that DOG] was rather slow.
c. Last night, a dog chased a cat in front of my house. ??Fortunately, [that DOG] was pretty slow, while [that CAT] was pretty fast.

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(2) a. Last night, a dog chased a cat in front of my house. Fortunately, [that CAT] was pretty fast.
b. Last night, a dog chased a cat in front of my house. Fortunately, [that DOG] was pretty slow.
c. Last night, a dog chased a cat in front of my house. Fortunately, [that CAT] was pretty fast, while [the DOG] was rather slow
d. Last night, a dog chased a cat in front of my house. Fortunately, [that DOG] was rather slow, while [the CAT] was pretty fast.

(3) a. [THAT dog] is smarter than [THAT dog].
b. [That DOG] is smart, but [that CAT] is rather stupid.

The pattern exemplified by the sentences in (1)-(3) is entirely unexpected on the accounts of King (2001) and Elbourne (2008) (see also Nowak, 2014), who both predict complex demonstratives to be essentially equivalent to definite descriptions on all uses except the deictic ones. I will therefore show that the pattern in (1)-(3) gives us a clue regarding the correct analysis of complex demonstratives and what sets them apart from definite descriptions: It provides an indirect argument for the assumption that complex demonstratives not only on their deictic, but also on their anaphoric or bound uses involve (abstract) *demonstrations* (Bühler, 1934; Roberts, 2002). Crucially, I will argue that the more restricted behavior of anaphoric or bound complex demonstratives as opposed to both anaphoric or bound definite descriptions and deictically used complex demonstratives can naturally be accounted for via the following assumption: Demonstrations may not have overlapping paths.

The paper is structured as follows. In Section 2 I give a brief overview over previous analyses of complex demonstratives. Section 3 discusses the pattern to be accounted for in more detail and shows why none of the previous analyses can account for it. In Section 4 I present my own analysis. Section 5 is the conclusion.

2. Previous analyses of complex demonstratives

2.1 Complex demonstratives as directly referential terms

In formal semantics and philosophy of language, there has for a long time been a focus on deictic uses of complex demonstratives, i.e. on uses where they refer to a contextually salient individual and where their utterance is accompanied by a pointing gesture in the direction of that individual, as in (4), which is assumed to be uttered in the presence of a dog pointed at by the speaker.

(4) That dog is really smart!

Kaplan (1989) assumes both simplex demonstratives such as *this* and *that* occurring on their own and complex demonstratives to be directly referential terms whose reference is fixed in the utterance situation by the speaker's demonstration (which can, but need not be a pointing gesture; all that is required is that the individual referred to is the focus of the addressee's attention at the utterance time). On this view, simplex and complex demonstratives only differ insofar as in the case of complex demonstratives, reference is only established if the individual being demonstrated satisfies the predicate denoted by the NP-complement of the demonstrative determiner (see Braun, 2008 for discussion). Crucially, complex demonstratives are assumed to be fundamentally different from definite descriptions since the reference of definite descriptions is not fixed by the utterance situation. Rather, they refer to the unique individual satisfying the predicated denoted by the NP-complement of the definite determiner (if there is such an individual), where uniqueness is potentially relativized with respect to a situation rather than a possible world.

To see the difference, consider the sentences in (5a) and (5b), uttered in a situation where it is known to both speaker and hearer(s) that (a) Martina is from Cologne and Frederik is from Wuppertal, (b) both Martina and Frederik are sitting on a chair in front of the speaker and (c) the speaker is pointing at Martina while uttering the respective sentence.

(5) a. If Martina and Frederik had changed places, then the person being pointing at would be from Wuppertal
b. If Martina and Frederik had changed places, then this person being pointed at would be from Wuppertal.

The sentence in (5a) is clearly true in such a situation. Assuming counterfactual conditionals to express universal quantification over possible worlds where the antecedent proposition is true and that are otherwise as similar as possible to the world of evaluation (Lewis, 1973), the definite description in (5a) denotes in each world quantified over the unique individual being pointed at by the speaker in that world, which is Frederik. Since Frederik is from Wuppertal in the world of evaluation, he continues to be so in the worlds quantified over, and the sentence is consequently true. Concerning the complex demonstrative in (5b), in contrast, its reference is fixed once and for all by the speaker's demonstration in the utterance situation. Consequently, the counterfactual worlds quantified over do not contain the unique individual satisfying the property of being a person pointed at by the speaker in that world. Rather, they contain the individual that the speaker points at in the utterance situation, which is Martina. Since Martina is from Cologne and continues to be so in the worlds quantified over since there is no reason to assume that changing places with Frederik changes her birthplace, (5b) is false.

2.2 Non-deictic uses of complex demonstratives

Various researchers have pointed out that there are numerous uses of complex demonstratives where they are clearly neither deictic nor directly referential (Gundel et al., 1993; King, 2001; Roberts, 2002; Wolter, 2006; Elbourne, 2008; Nowak, 2014). On many of these uses, they behave more or less analogously to definite descriptions. Consider the sentences in (6a) and (6b) first (from King, 2001), which are both assumed to be uttered in a situation where the speaker does not have any particular person in mind that she intends to refer to, but rather believes on purely general grounds that there is exactly one student who satisfies the predicate denoted by the NP-complement of the respective determiner. In such a situation, it does not seem to make much of a difference whether the speaker uses the demonstrative determiner *that* or the definite determiner, the only potential difference being that the demonstrative determiner is more emphatic.

(6) a. That student who scored one hundred on the exam is a genius.
b. The student who scored one hundred on the exam is a genius.

Similarly, not only the definite description in (7b), but also the complex demonstrative in (7a) receives a bound variable-like interpretation along the lines of the paraphrase in (7c).

(7) a. Mary talked to no senator without declaring afterwards that that senator would cosponsor her bill.
b. Mary talked to no senator without declaring afterwards that the senator would cosponsor her bill.
c. No senator *x* is such that Mary would talk to *x* without declaring afterwards that *x* would cosponsor her bill.

Abbott (2002) observes that for donkey sentences like (8a) and (9a), where a pronoun picks up a discourse referent introduced by an indefinite DP that does not c-command it, replacing the pronoun by a complex demonstrative (as in (8b) and (9b)) sounds more natural than replacing it by a definite description (as in (8c) and (9c)).

(8) a. Last night, I saw a dog in front of my house. It looked really hungry.
b. Last night I saw a dog in front of my house. That dog looked really hungry.
c. Last night, I saw a dog in front of my house. The dog looked really hungry.

(9) a. When I see a dog in front of my house at night, it usually looks really hungry.
b. When I see a dog in front of my house at night, that dog usually looks really hungry.
c. When I see a dog in front of my house at night, the dog usually looks really hungry.

2.3 Unified accounts of complex demonstratives

While Braun (2008) assumes the demonstrative determiner to be lexically ambiguous between a directly referential interpretation along the lines of Kaplan (1989) and an interpretation on which it is a (potentially more emphatic) version of the definite determiner, King (2001), Roberts (2002) and Elbourne (2008) all argue for a unified account of all uses of complex demonstratives (see also Wolter, 2006 for a related approach).

2.3.1 Complex demonstratives as definites with an additional predicate variable: The analyses of King (2001) and Elbourne (2008)

Although they are technically quite different, the analyses of King (2001) and Elbourne (2008) are similar insofar as they both treat demonstrative determiners to be essentially a variant of the definite determiner: While a definite description denotes the unique individual that satisfies the predicated denoted by its NP-complement, a complex demonstrative denotes the unique individual that satisfies both the predicate denoted by the NP-complement of the demonstrative determiner and some additional, contextually determined property that is given in the form of a free predicate variable. Additionally, Elbourne (2008) assumes the demonstrative determiner *this* to require the individual denoted by the complex demonstrative to be proximal to the speaker, while the demonstrative determiner *that* requires it to be distal. Since the difference between *this* and *that* plays no role for the data discussed in this paper, I will set it aside.

In a case like (4), where the speaker intends to refer to a perceptually salient individual and the use of the complex demonstrative is accompanied by a pointing gesture in the direction of that individual, the free predicate variable is assumed to be resolved to the property of being identical to the individual that the speaker intends to refer to. Assuming that the dog being pointed at by the speaker is Rover, the sentence in (4) is thus interpreted as shown in (10) in simplified form.

(10) $\text{smart}(\iota x.\ \text{dog}(x) \wedge \text{identical\_to}(\text{Rover}, x))$

In a case like (6a), in contrast, the free predicate variable is assumed to be resolved to some trivial property like existing, which in effect causes the complex demonstrative to have the same denotation as the definite description in (6b). King (2001) does not provide a detailed analysis of bound variable-like interpretations of complex demonstratives as in (7a), but the mechanism proposed by Elbourne (2008) can be implemented in King's (2001) framework as well: The free predicate variable is resolved to the property of being identical to (the value of) the variable bound by the respective quantifier. The sentence in (6a) is thus interpreted as paraphrased in (11).

(11) For no senator *x*: Mary talked to *x* without declaring afterwards that the unique *y* which is both a senator and identical to *x* cosponsored her bill.

Donkey sentences with complex demonstratives are not discussed by King (2001), but only by Elbourne (2008), who assumes them to be interpreted in essentially the same way in which he assumes donkey sentences with pronouns (which he takes to be definite descriptions with covert NPs) and definite descriptions to be interpreted (Elbourne, 2001; Elbourne, 2005; Elbourne, 2013): There is no direct binding relation between the indefinite DP and the pronoun, definite description or complex demonstrative. Rather, the latter end up denoting the discourse referents introduced by the former as an indirect effect of the binding of a situation variable. Following Kratzer (1989), Elbourne (2001; 2005; 2008; 2013) assumes all predicates (i.e. nominal as well as verbal and adjectival ones) to take additional situation arguments.

In sentences like (9a-c) with overt quantificational adverbs such as *always* and *usually* or in generic sentences, which are assumed to contain a covert generic quantifier with quasi-universal force, those situation arguments are turned into bound variables. Consequently, the sentences express quantification over minimal situations satisfying the respective restrictor and nucleus predicates, where situations are minimal with respect to a situation predicate if they contain nothing more than what is required to satisfy that predicate. Now, the quantificational adverb binds the situation variable of the indefinite in the restrictor as well as the situation variable of the pronoun, definite description or complex demonstrative in the nucleus. Consequently, since the situations quantified over are minimal with respect to the restrictor and nucleus predicates, the individual denoted by the pronoun, definite description or complex demonstrative in each situation ends up being identical to the individual introduced by the indefinite. The sentences in (9a-c) are thus (roughly) interpreted as paraphrased in (12).

(12) Most situations *s* which are minimal situations of there being a dog *x* such that the speaker sees *x* in front of his house at night are such that there is a situation *s*′ which is a minimal extension of *s* such that the unique *y* which is a dog in *s*′ looks hungry in *s*′.

Episodic sentences are assumed to contain covert existential quantifiers over minimal situations. For cases like (8a-c), the situation introduced by the covert existential quantifier in the second sentence is automatically understood as an extension of the situation introduced by the first sentence. Consequently, we arrive at the interpretation paraphrased in (13), which ensures that the pronoun, definite description or complex demonstrative in the second sentence ends up denoting the same individual as the one introduced by the indefinite in the first sentence.

(13) There is a minimal situation *s* of there being a dog *x* in front of the speaker's house such that the speaker sees *x* in *s*, and there is a minimal extension *s*′ of *s* such that the unique *z* which is a dog in *s*′ looks hungry in *s*′.

Since King (2001), like Elbourne (2008), assumes non-deictic uses of complex demonstratives to be essentially equivalent to definite descriptions, he could either modify his framework along the lines of Elbourne (2008) in order to account for donkey uses of complex demonstratives, or adopt a strategy similar to the one that has originally been proposed for donkey pronouns (Evans, 1977; Cooper, 1979; Heim, 1990): The free predicate variable would then be resolved in such a way that it ends up denoting the same individuals as those introduced by the respective indefinite.

2.3.2 Complex demonstratives as definites presupposing speaker demonstrations: The analysis of Roberts (2001)

In contrast to King (2001) and Elbourne (2008), Roberts (2002) assumes demonstratives to differ from definite descriptions in a fundamental respect: On all their uses, they presuppose a speaker demonstration. For deictic uses, the demonstration is a concrete pointing gesture in physical space, and the demonstratum is an individual present in the utterance situation. For anaphoric or bound uses, in contrast, the demonstration is an abstract demonstration in discourse, and the demonstratum is a previously uttered DP that introduces or picks up the same discourse referent as the one denoted by the complex demonstrative.

Robert's (2002) analysis is couched in a dynamic framework along the lines of Heim's (1982) context change semantics. Going into the technical details would take us too far afield, but the basic idea is that all utterances are interpreted in a context *C* which is conceived of as an ordered pair consisting of a domain and a satisfaction set. The domain of C, Dom_C, is the set of familiar discourse referents, and the satisfaction set of C, Sat_C, is the shared information of speaker and addressee(s) about the discourse referents – a set of world-assignment pairs $<w,g>$ such that for all discourse referents $i \in Dom_C$, the individual assigned to i by g verifies in w all the information the interlocuters share about i. The meaning of an utterance is now conceived of as its context change potential, i.e. the information it potentially adds to a context C in which it is uttered. While indefinites introduce novel discourse referents, definites presuppose the existence of a unique discourse referent $i \in Dom_C$ such that for all $<w,g> \in Sat_C$, $g(i)$ satisfies the (possibly liberalized) descriptive content of the NP in w. Note that in Robert's (2002) system, uniqueness is relaxed in two ways: First, insofar as only informational uniqueness is required, i.e. it is not required that there is a unique entity satisfying the respective predicate in the actual world, but only that there is a unique such entity in the common ground (Stalnaker, 1978; 2002) of speaker and addressee(s). Second, insofar as the referent of the definite description does not necessarily have to be (informationally) unique in satisfying the *actual* descriptive content of the NP, but only its *liberalized* descriptive content, i.e. the predicate denoted by the overt NP in combination with other predicates that the referent of the definite description is contextually entailed to satisfy.

The presuppositions of complex demonstratives subsume those of definites, with an additional presupposition added: They presuppose that there is a demonstration δ of the speaker in C such that either the demonstratum of δ (in case δ is pointing gesture in physical space) or the discourse referent associated with the demonstratum in δ (in case δ is a pointing gesture in discourse space and the demonstratum of δ is a previously uttered DP) is the unique discourse referent $i \in Dom_C$ such that for all $<w,g> \in Sat_C$, $g(i)$ satisfies the (possibly liberalized) content of the NP-complement of the demonstrative determiner in w.

For deictic uses, the presuppositions of the complex demonstrative are satisfied if the utterance of the complex demonstrative is accompanied by a pointing gesture to an individual that is present in the utterance situation, and if that individual is the unique familiar entity satisfying the (possibly liberalized) descriptive content of the complex demonstrative. In the case of (4), repeated here as (14), the presuppositions of the complex demonstrative *that dog* are satisfied if (a) the speaker points at an individual while uttering the complex demonstrative and (b) the individual she points at is the unique entity in the common ground of speaker and addressee(s) that satisfies the (in that case quite likely liberalized) descriptive content of the noun *dog*.

(14) That dog is really smart!

For donkey uses such as (8b), repeated here as (15), the presuppositions of the complex demonstrative are satisfied if (a) there is an abstract speaker demonstration in discourse to a DP and (b) the discourse referent introduced by that DP is the unique familiar entity satisfying the (possibly liberalized) descriptive content of the complex demonstrative. In the case of (8b)/(15), the presuppositions of the complex demonstrative *that dog* are thus satisfied in any context in which the two sentences are uttered, since there is a DP in the preceding sentence that the speaker can plausibly be assumed to have demonstrated, namely the indefinite *a dog*, and the discourse referent introduced by that DP is the unique familiar entity satisfying the liberalized descriptive content of the noun *dog*, i.e. a predicate such as *dog seen by the speaker last night in front of his house*.

(15) Last night, I saw a dog in front of my house. That dog looked really hungry.

Roberts (2002) explicitly cites examples with complex demonstratives bound by quantificational DPs as counterarguments against the assumption that complex demonstratives are necessarily directly referential. It is not quite clear to me how she accounts for such cases as well as for donkey sentences with quantificational adverbs, since in both cases there is no single discourse referent introduced by the demonstrated DP, but rather a multiplicity. Since my own analysis, which is presented in Section 4, builds on Roberts (2002) but implements her idea in a different framework, I will not speculate on how sentences with complex demonstratives that are directly or indirectly bound by (nominal or adverbial) quantifiers can be accounted for in Roberts (2002) system.

3. The pattern to be accounted for

Consider again the contrast between (1a), repeated here as (16a), on the one hand, and (2b) and (2c), repeated here as (16b) and (16c), on the other. While it is entirely natural to pick up the discourse referents introduced by the two indefinites in the first sentence by definite descriptions in the second sentence, picking them up by complex demonstratives is infelicitous. The order in which the discourse referents are picked up does not matter, i.e. whether the last mentioned one is picked up by the first or by the second complex demonstrative does not have any influence on the felicity of the resulting text segment.

(16) a. Last night, a dog chased a cat in front of my house. Fortunately, [the CAT] was pretty fast, while [the DOG] was rather slow.
b. Last night, a dog chased a cat in front of my house. ??Fortunately, [that CAT] was pretty fast, while [that DOG] was rather slow.
c. Last night, a dog chased a cat in front of my house. ??Fortunately, [that DOG] was pretty slow, while [that CAT] was pretty fast.

As shown by (17), it also does not help when the last mentioned discourse referent is picked up by a complex demonstrative headed by *this*, while the first mentioned one is picked up by a demonstrative headed by *that*.

(17) Last night, a dog chased a cat in front of my house. ??Fortunately, [this CAT] was pretty fast, while [that DOG] was rather slow.

At the same time, the felicity of (2a-d), repeated here as (18a-d), shows that whenever only one of the two discourse referents is picked up by a complex demonstrative, the resulting text segment is felicitous, irrespective of whether it is the first or the second one, and irrespective of whether the other discourse referent is not picked up at all, or picked up by a definite description.

(18) a. Last night, a dog chased a cat in front of my house. Fortunately, [that CAT] was pretty fast.
b. Last night, a dog chased a cat in front of my house. Fortunately, [that DOG] was pretty slow.
c. Last night, a dog chased a cat in front of my house. Fortunately, [that CAT] was pretty fast, while [the DOG] was rather slow
d. Last night, a dog chased a cat in front of my house. Fortunately, [that DOG] was rather slow, while [the CAT] was pretty fast.

The same pattern holds in German, as evidenced by the results of an acceptability study in the form of a yes/no-judgement task in which participants (36 students from the University of Cologne) were presented one of the four variants of 38 short texts consisting of two sentences like those in (19), interspersed with the same amount of fillers. Participants were instructed that these were beginnings of stories produced by advanced German learners and their task was to judge whether the students had reached German native proficiency (by responding "yes, they have" or "no, they haven't").

(19) Im Zoo hat gestern ein Schimpanse einen Zoowärter angespuckt.
In the zoo, a chimpanzee spit at a zoo keeper yesterday.
a. Dann hat der Schimpanse den Zoowärter auch noch angegriffen.
Then the chimpanzee also attacked the zoo keeper.
b. Dann hat der Schimpanse diesen Zoowärter auch noch angegriffen.
Then the chimpanzee also attacked that zoo keeper.
c. Dann hat dieser Schimpanse den Zoowärter auch noch angegriffen.
Then that chimpanzee also attacked the zoo keeper.
d. Dann hat dieser Schimpanse diesen Zoowärter auch noch angegriffen.
Then that chimpanzee also attacked that zoo keeper.

As shown in Figure 1, the condition with the two complex demonstratives (light grey column on the left) was rated as native significantly less often than the other three conditions. At the same time, there were no significant differences between the other conditions.

Unsurprisingly, the pattern exemplified by (16a-c) and (19a-d) also obtains in donkey sentences with quantificational adverbs, as shown by (20a-e).

(20) a. When a dog chases a cat in front of my house, [the CAT] is usually pretty fast, while [the DOG] is rather slow.
b. ??When a dog chases a cat in front of my house, [that CAT] is usually pretty fast, while [that DOG] is rather slow.
c. ??When a dog chases a cat in front of my house, [that DOG] is usually rather slow, while [that CAT] is pretty fast.
d. When a dog chases a cat in front of my house, [that DOG] is usually rather slow, while [the CAT] is pretty fast.
e. When a dog chases a cat in front of my house, [that CAT] is usually pretty fast, while [the CAT] is pretty fast.

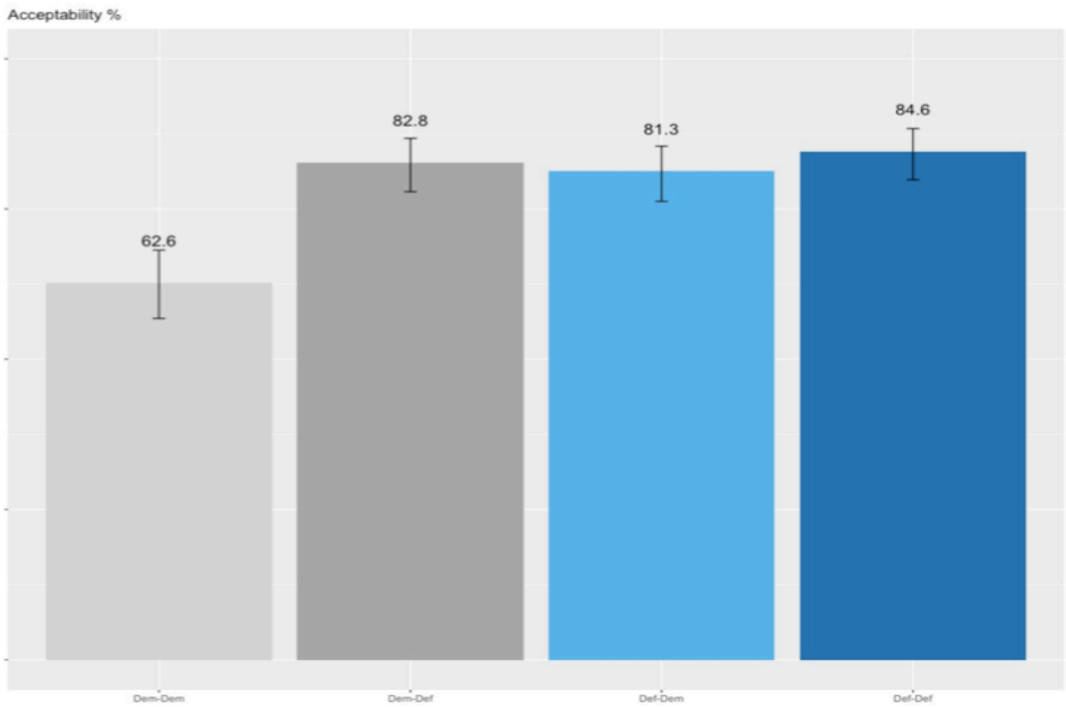

Figure 1. Response proportions for the respective conditions, where *Dem-Dem* is the condition with two complex demonstratives (as in (19d)), *Dem-Def* the condition with a complex demonstrative followed by a definite description (as in (19c), *Def-Dem* the condition with a definite description followed by a complex demonstrative (as in (19b) and *Def-Def* the condition with two definite descriptions (as in (19a)).

Consider next the sentences in (21a-c). In the case of (21a), (21c) and (21d), co-varying interpretations are easily available for both demonstratives, while (21b) is rather infelicitous.

(21) a. Mary gave no child a cookie before [the child] had thanked her for [the cookie].
b. ??Mary gave no child a cookie before [that child] had thanked her for [that cookie].
c. Mary gave no child a cookie before [that child] had thanked her for [the cookie].
d. Mary gave no child a cookie before [the child] had thanked her for [that cookie].

Crucially, in order for the definite description *the child* or the complex demonstrative *that child* to receive bound variable-like interpretations, the negative quantifier *no child* has to c-command them, i.e. we have to assume that *no child* c-commands the adjunction site of the *before*-clause. Since the pattern in (21a-d) is the same pattern that we have observed in cases where there is no c-command relation between the complex demonstratives and their antecedents, I conclude that linear precedence is the crucial notion and c-command plays no role: The co-occurrence of two complex demonstratives that are anaphorically related to or bound by DPs linearly preceding them leads to infelicity.

Finally, both (3a) and (3b), repeated here as (22a) and (22b), are felicitous when the utterance of the respective complex demonstrative is accompanied by a pointing gesture in the direction of a perceptually salient individual of the right kind. This shows that the infelicity of sentences with two anaphoric or bound complex demonstratives is neither due to a general constraint against the occurrence of more than one demonstrative in a sentence, nor a constraint that prevents demonstratives with contrasting NPs from co-occurring.

(22) a. [THAT dog] is smarter than [THAT dog].
b. [That DOG] is smarter than [that CAT].

Let us now turn to the question of whether the pattern under consideration can be accounted for by any of the analyses that we have discussed in Section 2.

Let us start with the analyses proposed by King (2001) and Elbourne (2008). As already said in Section 2, both King (2001) and Elbourne (2008) assume complex demonstratives to only differ from definite descriptions insofar as they introduce an additional covert predicate variable that needs to be resolved on the basis of contextual information. The presence of that variable enables complex demonstratives to receive deictic interpretations on which they are directly referential, since the variable is then resolved to the property of being identical to the entity demonstrated by the speaker in the utterance situation. On all other uses, however, complex demonstratives are predicted to behave in the same way as definite descriptions. Consequently, there should be no contrast between sentences with two definite descriptions picking up discourse referents introduced in the previous sentence and sentences with two complex demonstratives.

Now, it might at first sight be tempting to try to account for the infelicity of sentences with two anaphoric complex demonstratives by combining a semantic analysis of complex demonstratives along the lines of King (2001) and Elbourne (2008) with a pragmatic account based on the following idea: Complex demonstratives are more marked than definite descriptions in virtue of being not only morphologically, but also semantically more complex (due to the additional predicate variable), just like so-called demonstrative pronouns of the *der*/*die*/*das*-variety are more marked than the personal pronouns *er*/*sie*/*es* (‘he’/’she’/’it’) in German and thus have a more limited distribution (Patel-Grosz and Grosz, 2017). More specifically, it is well-known that demonstrative pronouns (DemPros) have a strong tendency to pick up less prominent antecedents, where prominence has been defined in terms of subjecthood (Bosch et al., 2003), topicality (Bosch and Umbach, 2007; Hinterwimmer 2015), proto-agentivity (Schumacher et al., 2016, 2017) and perspective-taking (Hinterwimmer and Bosch, 2016, to appear). Concerning the sentence in (23), for example, there is a strong tendency to interpret the demonstrative as picking up the donkey introduced by the indefinite, although it is rather implausible that a donkey is wealthy. This is expected, since (the proper name referring to) Peter is more prominent in virtue of being the subject, the topic (by default) and the proto-agent (Dowty, 1991).

(23) Peter besitzt einen Esel. Der ist
Peter owns a-ACC donkey DemPro-MASC-NOM-SING is
ziemlich wohlhabend.
rather wealthy
‘Peter owns a donkey. It is rather wealthy.’

Applying a similar reasoning to definite descriptions and complex demonstratives, one could now argue that in virtue of being more marked, complex demonstratives have a strong tendency to pick up less prominent antecedents. Consequently, whenever one of two previously introduced discourse referents is picked up by a complex demonstrative, the corresponding discourse referent is automatically signaled to be taken as less prominent by the speaker than the other discourse referent. But then picking up the other discourse referent by a complex demonstrative as well becomes awkward, since that discourse referent is thereby signaled to be taken as less prominent by the speaker than the one picked up by the first complex demonstrative, which is of course contradictory.

Concerning sentences with two deictically used complex demonstratives such as (3a)/(22a) and (3b)/(22b), in contrast, that reasoning does not apply since there is an independent reason to choose complex demonstratives instead of definite descriptions – namely to arrive at a directly referential interpretation via resolving the free predicate carriable to the property of being identical to the demonstrated entity. It is only on their non-deictic uses, where complex demonstratives are predicted to be semantically equivalent to definite descriptions by King (2001) and Elbourne (2008), that we expect them to compete with definite descriptions.

Attractive as such a reasoning might seem at first, it faces a serious problem. Whenever only one of the two previously discourse referents is picked up by a complex demonstrative and the other by a definite description, we would expect there to be a contrast in acceptability between the two following combinations: Cases where the discourse referent introduced by a subject DP that is at the same time the (proto-)agent is picked up by a definite description, and the one introduced by an object DP that is at the same time the patient or theme is picked up by a complex demonstrative should be more felicitous than cases where it is the other way around. Consequently, text segments such as (18c) and (19b), repeated here as (24a) and (25a), respectively, should be more felicitous than text segments such as (18d) and (19c), repeated here as (24b) and (25b), respectively. The reason is that subjecthood and (proto-)agentivity should at least make discourse referents maximally prominent by default, i.e. in the absence of contextual information promoting other discourse referents to topics.

(24) a. Last night, a dog chased a cat in front of my house. Fortunately, [that CAT] was pretty fast, while [the DOG] was rather slow
b. Last night, a dog chased a cat in front of my house. Fortunately, [that DOG] was rather slow, while [the CAT] was pretty fast.

(25) Im Zoo hat gestern ein Schimpanse einen Zoowärter angespuckt.
In the zoo, a chimpanzee spit at a zoo keeper yesterday.
a. Dann hat der Schimpanse diesen Zoowärter auch noch angegriffen.
Then the chimpanzee also attacked that zoo keeper.
b. Dann hat dieser Schimpanse den Zoowärter auch noch angegriffen.
Then that chimpanzee also attacked the zoo keeper.

This prediction is not borne out, however: Intuitively, there is no contrast in acceptability between (24a) and (25a), on the one hand, and (24b) and (25b), on the other, and for sentences such as (26a) and (26b) this has been confirmed by the experimental evidence reviewed above: The latter were rated as native (almost) as often as the former (see Figure 1). To make things worse, in the case of sentences mixing demonstrative and personal pronouns it does make a difference which one of the two previously introduced discourse referents is picked up by a personal pronoun and which one by a demonstrative pronoun. To see this, consider the sentences in (26a) and (26b).

(26) Im Zoo hat gestern ein Schimpanse einen Zoowärter angespuckt.
In the zoo, a chimpanzee spit at a zoo keeper yesterday.
a. Dann hat er den auch noch angegriffen.
Then he also attacked him(DemPro).
b. Dann hat der ihn auch noch angegriffen.
Then he(DemPro) also attacked him.
c. Dann hat der den auch noch angegriffen.
Then he(DemPro) also attacked him(DemPro).

In the case of (26a), the personal pronoun is automatically interpreted as picking up the zoo keeper, resulting in a coherent interpretation. The sentence in (26b), in contrast, is incoherent. The demonstrative pronoun can only be interpreted as picking up the zoo keeper, and the personal pronoun as picking up the chimpanzee. Such an interpretation clashes with the presupposition of *auch noch*, ('also'), however, which requires there to be another contextually salient action by the zoo keeper, not by the chimpanzee. Demonstrative pronouns, in contrast to complex demonstratives, thus behave as predicted by a pragmatic account based on markedness. Finally, according to my (native speaker's) intuitions, the sentence in (26c) with two demonstrative pronouns is coherent (with the subject pronoun picking up the chimpanzee, and the object pronoun picking up the zoo keeper) and slightly marked, but far more felicitous than the sentences with two complex demonstratives in (16b-c) and (19d). This is as predicted: Since violating the preference of demonstrative pronouns for less prominent antecedents once cannot be avoided anyway, the hearer is free to resolve the demonstrative pronoun in such a way that a coherent interpretation results. At the same time, the violation of a pragmatically derived constraint results in (slight) markedness, but does not make the sentence completely infelicitous. The infelicity of the sentences in (16b-c) and (19d), in contrast, suggest that a semantic instead of a pragmatic constraint is violated.

Let us now turn to the analysis proposed by Roberts (2002), according to which complex demonstratives on their anaphoric uses presuppose abstract demonstrations in discourse by the speaker such that the discourse referents introduced by the demonstrated DPs are the unique familiar discourse referents satisfying the (possibly liberalized) descriptive content of those DPs. As it stands, the analysis does not predict the infelicity of sentences with two complex demonstratives picking up discourse referents introduced in the previous sentence. Let us consider the text segment in (16b), for instance, repeated here as (27).

(27) Last night, a dog chased a cat in front of my house. ??Fortunately, [that CAT] was pretty fast, while [that DOG] was rather slow.

The complex demonstratives *that cat* presupposes an abstract demonstration in discourse such that the demonstrated DP introduces a discourse referent that is the unique familiar discourse referent satisfying the (quite likely liberalized) descriptive content of the complex demonstrative. Now, the previous sentence contains a DP that can plausibly be assumed to be demonstrated by the speaker, namely the indefinite DP *a cat*. That DP introduces a discourse referent that by the time at which the complex demonstrative is interpreted is the unique familiar discourse referent satisfying the predicate *cat chased by a dog in front of the speaker's house* (assuming that predicate to be the liberalized semantic content of the complex demonstrative). Concerning the complex demonstrative *that dog*, the same reasoning applies. Again, the previous sentence contains a DP that can plausibly be assumed to be demonstrated by the speaker, namely the indefinite DP *a dog*. Since that DP introduces a discourse referent that by the time at which the complex demonstrative is interpreted is the unique familiar discourse referent satisfying the predicate *dog that chased a cat in front of the speaker's house last night* (assuming that predicate to be the liberalized semantic content of the complex demonstrative), all presuppositions are satisfied and the sentence is accordingly predicted to be felicitous.

We have just seen that as it stands, the analysis of complex demonstratives proposed by Roberts (2002) does not predict sentences with two anaphoric complex demonstratives to be infelicitous. In Section 4 I will show, however, that by combining the basic idea behind that approach with a simple general principle we arrive at an analysis that makes the right predictions.

4. The Analysis

As we have seen in the previous sections, the generalization we want to account for is that two (or more) complex demonstratives are not allowed to co-occur in a sentence if they are anaphorically related to DPs in the preceding sentence. I propose to capture this generalization by combining Robert's (2002) assumption that demonstratives on all their uses presuppose (concrete or abstract) demonstrations with the assumption that the trajectories of such demonstrations may not overlap.

Let us assume that the utterance of a sentence in a conversation not only causes the introduction of discourse referents for the entities talked about in that sentence, and for the proposition it denotes, but also for the sentence itself and all of its constituents. Likewise, for sequences of sentences uttered in a discourse, discourse referents for the corresponding text segments are introduced. Crucially, discourse referents for sentences and text segments contain information concerning the linear sequence of their constituents. Demonstrations in discourse therefore occur in a discourse space set up by those linear sequences, and the trajectories of demonstrations in discourse connect the position of a demonstrative in the currently uttered sequence with the position of some DP in a previously uttered sequence. The trajectories of demonstrations in discourse therefore necessarily overlap whenever there is more than one demonstrative anaphorically related to a DP in a previous sentence. Concerning concrete demonstrations in three-dimensional space, in contrast, it is (almost) never the case that their trajectories necessarily have to be construed as overlapping – even in cases of seemingly crossing trajectories, one trajectory can always be construed as been placed slightly above or below the other one.

Consider again the text segments in (16b)/(27) and (16c), repeated here as (28a) and (29a), respectively. In (28b) and (29b), schematic representations of the demonstrations presupposed by the complex demonstratives in the second sentence are given, with the arrows visualizing the trajectories of the demonstrations.

(28) a. Last night, a dog chased a cat in front of my house. $^{??}$Fortunately, [that CAT] was pretty fast, while [that DOG] was rather slow.
b. … a dog … a cat … that cat … that dog …

(29) a. Last night, a dog chased a cat in front of my house. $^{??}$Fortunately, [that DOG] was pretty slow, while [that CAT] was pretty fast.
b. … a dog … a cat … that dog … that cat …

Obviously, in both cases there is no possible demonstration whose trajectory links the position of the first demonstrative in the linear sequence to the position of its demonstratum that does not overlap with the trajectory that links the position of the second demonstrative in the linear sequence to the position of its demonstratum.

In (30) a lexical entry for the demonstrative determiner *that* is given that incorporates the assumptions just outlined. Following Link (1983), I assume the iota-operator to pick out the maximal element of the set it is applied to. For sets of sets of atomic individuals, maximality is only defined if they are singleton sets.

(30) $[[\text{that}]]^{C,w,g} = \lambda P_{<e,<s,t>>} . \lambda s . \iota\{x: P(x)(s) \wedge \exists y \in DOM_C\ \exists \delta_1 \in DOM_C\ \neg[\exists \delta_2 \in DOM_C$ $\exists z \in DOM_C\ [\text{Agent}(\delta_1)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_1)(y) \wedge$ $\text{interpretatively\_dependent\_on}(x)(y) \wedge \text{Agent}(\delta_2)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_2)(z)$ $\wedge\ z \neq y \wedge \text{overlap}(\text{trajectory}(\delta_1))(\text{trajectory}((\delta_2))]]\}$.

A1. If *y* is a concrete individual in physical space, *x* is interpretatively dependent on *y* iff *x* is identical to *y*.

A2. If *y* is a DP that is contained in a previously uttered sequence, *x* is interpretatively dependent on *y* iff *x* is either identical to the discourse referent introduced by *y* or to (the value of) a variable bound by *y*.

B1. If the demonstratum of a demonstration *δ* is a concrete individual *y* in physical space and the speaker is the agent of *δ*, the trajectory of *δ* connects the location of the speaker in the utterance situation with the location of *y* in the utterance situation.

B2. If the demonstratum of a demonstration *δ* is a DP that is contained in a previously uttered sequence and the speaker is the agent of *δ*, the trajectory of *δ* connects the location of the demonstrative determiner presupposing in the sequence of uttered words with the location of *y* in the previously uttered sequence.

In words: *that* takes a predicate *P* of type *<e,<s,t>>* and a situation *s* as arguments and maps them to the unique *x* such that
(a) *x* satisfies *P* in *s*,
(b) there is a (concrete or abstract) demonstration δ_1 in the domain of *C* whose agent is the speaker and whose demonstratum is a *y* on which *x* is interpretatively dependent,
(c) there is no (concrete or abstract) demonstration δ_1 in the domain of *C* whose agent is the speaker and whose demonstratum is a *z* distinct from *y* such that the trajectories of δ_1 and δ_2 overlap.

Let us now have a look at the felicitous example in (18c), repeated here as (31a), which combines a complex demonstrative and a definite description. The interpretation it receives on the proposed analysis is given in strongly simplified form in (31b). Note that I assume episodic sentences to contain covert existential quantifiers quantifying over minimal situations. Additionally, I assume that in cases of two episodic sentences immediately following each other in a narrative sequence, the situation introduced by the second sentence is automatically interpreted as a (minimal) extension of the first (see section 2.3.1 above). Since existential quantification over a minimal situation *s* satisfying *P* and a situation s_1 that is a minimal extension of *s* satisfying *Q* is equivalent to existential quantification over a minimal situation satisfying both *P* and *Q*, I have simplified the formula accordingly.

(31) a. Last night, a dog chased a cat in front of my house. Fortunately, [that CAT] was pretty fast, while [the DOG] was rather slow.
b. $\exists s[\min(s, \lambda s'. \exists x \exists y\, [dog(x)(s') \wedge cat(y)(s') \wedge chase(y)(x)(s') \wedge fast(\iota\{z: cat(z)(s')$
$\wedge\, \exists z_1 \in DOM_C\, \exists \delta_1 \in DOM_C\, \neg[\exists \delta_2 \in DOM_C\, \exists z_2 \in DOM_C\, [Agent(\delta_1)(Author(C)) \wedge$
$Demonstratum(\delta_1)(z_1) \wedge interpretatively\_dependent\_on(z)(z_1)$
$\wedge\, Agent(\delta_2)(Author(C)) \wedge Demonstratum(\delta_2)(z_2) \wedge z_1 \neq z_2$
$\wedge\, overlap(trajectory(\delta_1))(trajectory(\delta_2))]]\}) \wedge slow(\iota\{z_3: dog(z_3)(s')\})])]$

First, since the indefinite in the first sentence has introduced a cat, the situation bound by the existential quantifier contains a *z* that is a cat. Second, it is unproblematic to accommodate a demonstration whose agent is the speaker and whose demonstratum is a discourse referent on which *z* interpretatively depends–namely the previously uttered DP *a cat.* Third, there is no need to accommodate a second demonstration whose agent is the speaker and whose demonstratum is a familiar discourse referent such that the trajectories of the two demonstrations overlap. The application of the iota-operator therefore yields a defined result, and the text segment in (30a) receives a straightforward interpretation.

Let us now turn to the infelicitous example with two complex demonstratives in (28a), repeated here as (32a), and (29a), repeated here as (33a), and the (strongly simplified) interpretation they would receive on the proposed analysis in (32b) and (33b), respectively.

(32) a. Last night, a dog chased a cat in front of my house. ??Fortunately, [that CAT] was pretty fast, while [that DOG] was rather slow.
b. $\exists s[\min(s, \lambda s'. \exists x \exists y\, [dog(x)(s') \wedge cat(y)(s') \wedge chase(y)(x)(s') \wedge fast(\iota\{z: cat(z)(s')$
$\wedge\, \exists z_1 \in DOM_C\, \exists \delta_1 \in DOM_C\, \neg[\exists \delta_2 \in DOM_C\, \exists z_2 \in DOM_C\, [Agent(\delta_1)(Author(C))$
$\wedge\, Demonstratum(\delta_1)(z_1) \wedge interpretatively\_dependent\_on(z)(z_1)$
$\wedge\, Agent(\delta_2)(Author(C)) \wedge Demonstratum(\delta_2)(z_2) \wedge z_1 \neq z_2$
$\wedge\, overlap(trajectory(\delta_1))(trajectory(\delta_2))]]\}) \wedge slow(\iota\{z_3: dog(z_3)(s') \wedge \exists z_4 \in DOM_C$
$\exists \delta_3 \in DOM_C\, \neg[\exists \delta_4 \in DOM_C\, \exists z_5 \in DOM_C\, [Agent(\delta_3)(Author(C))$
$\wedge\, Demonstratum(\delta_3)(z_4) \wedge interpretatively\_dependent\_on(z_3)(z_4)$
$\wedge\, Agent(\delta_4)(Author(C)) \wedge Demonstratum(\delta_4)(z_5) \wedge z_4 \neq z_5$
$\wedge\, overlap(trajectory(\delta_3))(trajectory(\delta_4))]]\})])]$

(33) a. Last night, a dog chased a cat in front of my house. ??Fortunately, [that DOG] was pretty slow, while [that CAT] was pretty fast.
b. $\exists s[\min(s, \lambda s'. \exists x \exists y\, [\text{dog}(x)(s') \wedge \text{cat}(y)(s') \wedge \text{chase}(y)(x)(s') \wedge \text{slow}(\iota\{z: \text{dog}(z)(s') \wedge \exists z_1 \in \text{DOM}_C\, \exists \delta_1 \in \text{DOM}_C\, \neg[\exists \delta_2 \in \text{DOM}_C\, \exists z_2 \in \text{DOM}_C\, [\text{Agent}(\delta_1)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_1)(z_1) \wedge \text{interpretatively\_dependent\_on}(z)(z_1) \wedge \text{Agent}(\delta_2)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_2)(z_2) \wedge z_1 \neq z_2 \wedge \text{overlap}(\text{trajectory}(\delta_1))(\text{trajectory}(\delta_2))]]\}) \wedge \text{fast}(\iota\{z_3: \text{cat}(z_3)(s') \wedge \exists z_4 \in \text{DOM}_C\, \exists \delta_3 \in \text{DOM}_C\, \neg[\exists \delta_4 \in \text{DOM}_C\, \exists z_5 \in \text{DOM}_C\, [\text{Agent}(\delta_3)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_3)(z_4) \wedge \text{interpretatively\_dependent\_on}(z_3)(z_4) \wedge \text{Agent}(\delta_4)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_4)(z_5) \wedge z_4 \neq z_5 \wedge \text{overlap}(\text{trajectory}(\delta_3))(\text{trajectory}(\delta_4))]]\})])]$

Now, the first iota-operator in (32b) yields a defined result for exactly the same reasons as the iota-operator in (31b). For the second iota-operator, however, this is not the case. There is a *z* that is a dog in the situation bound by the existential quantifier and it is unproblematic to accommodate a demonstration δ_3 whose agent is the speaker and whose demonstratum is a familiar discourse referent on which *z* interpretatively depends – namely the previously uttered DP *a dog*. But there is another demonstration δ_4 by the speaker whose demonstratum is a familiar discourse referent such that the trajectories of δ_3 and δ_4 overlap – namely the demonstration whose trajectory connects the position of the complex demonstrative *that cat* and the position of the indefinite DP *a cat* in the linear sequence. Consequently, the application of the second iota-operator does not yield a defined result, and (32b) is not available as an interpretation of the text segment in (32a). Exactly the same reasoning applies to the second iota-operator in (33b), thus accounting for the infelicity of the text segment in (33a).

Let us finally consider the sentence in (22b), repeated here as (34a), and its interpretation in (34b).

(34) a. [That DOG] is smarter than [that CAT].
b. $\exists s[\min(s, \lambda s'. \text{smarter\_than}(\iota\{x: \text{dog}(x)(s') \wedge \exists y \in \text{DOM}_C\, \exists \delta_1 \in \text{DOM}_C\, \neg[\exists \delta_2 \in \text{DOM}_C\, \exists z \in \text{DOM}_C\, [\text{Agent}(\delta_1)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_1)(y) \wedge \text{interpretatively\_dependent\_on}(x)(y) \wedge \text{Agent}(\delta_2)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_2)(z) \wedge z \neq y \wedge \text{overlap}(\text{trajectory}(\delta_1))(\text{trajectory}((\delta_2))]]\})(\iota\{x: \text{cat}(x)(s') \wedge \exists y \in \text{DOM}_C\, \exists \delta_1 \in \text{DOM}_C\, \neg[\exists \delta_2 \in \text{DOM}_C\, \exists z \in \text{DOM}_C\, [\text{Agent}(\delta_1)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_1)(y) \wedge \text{interpretatively\_dependent\_on}(x)(y) \wedge \text{Agent}(\delta_2)(\text{Author}(C)) \wedge \text{Demonstratum}(\delta_2)(z) \wedge z \neq y \wedge \text{overlap}(\text{trajectory}(\delta_1))(\text{trajectory}((\delta_2))]]\})(s'))]$

If (34a) is uttered in a situation where both a dog and a cat are present and where the speaker points at the dog and the cat, both iota-operators in (34b) are guaranteed to yield defined results when they are applied to the respective sets since it is never the case that the trajectories of the two demonstrations necessarily overlap. Even in a case where the speaker is standing in the middle of a room, pointing at the cat that is sitting in the right corner in front of her with her left hand and at the dog that is sitting in the left corner in front of her with her right hand, the trajectory of the first demonstration can be construed as slightly below or above the trajectory of the other one, thus avoiding overlap.

5. Conclusion

In this paper I have argued for an analysis of complex demonstratives which builds on Roberts (2002) assumption that demonstratives, not only on their deictic, but also on their anaphoric or bound uses, involve (concrete or abstract) demonstrations. Based on the observation that sentences with two complex demonstratives are infelicitous when the demonstratives are anaphorically related to or bound by linearly preceding DPs, but not when they are used deictically, I have proposed that the demonstrations presupposed by complex demonstratives may not have overlapping trajectories. Finally, by comparing the behavior of complex demonstratives to that of German demonstrative pronouns, I have shown that the proposed analysis is more adequate than a pragmatic prominence-based account.

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Competition between the German root modal *sollen* and the imperative[1]

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Abstract. In this paper we analyse the complementary distribution in German between the imperative–which is performative–and the root modal *sollen* 'be supposed to'–which appears to be anti-performative (Glas, 1984; Diewald, 1999; Hinterwimmer, 2013; Bochnak and Csipak, 2018). We argue that the imperative and root *sollen* share a bouletic meaning (broadly "x wants at t in w for y to do P") but carry opposite requirements on the parameters of this bouletic attitude. The imperative requires $<x,y,t,w> = <c_{Sp}, c_{Ad}, c_T, c_W>$, i.e. the parameters are identified with the utterance context (Kaplan, 1989). The imperative must express an actual-world speaker request of the addressee. The root modal *sollen* inversely requires $<x,y,t,w> \neq <c_{Sp}, c_{Ad}, c_T, c_W>$ and is thus prohibited from expressing an actual speaker request of the addressee. We argue that this account is a step ahead relative to earlier accounts of the non-performativity of root *sollen* (Hinterwimmer, 2013; Bochnak and Csipak, 2018). We also compare root *sollen* to the English modal *be supposed to*. We argue that *be supposed to* carries the stronger requirement $<x,t,w> \neq <c_{Sp}, c_T, c_W>$ that excludes the expression of all actual speaker preferences, whether or not they concern an action by the addressee. We argue against an account in terms of formal competition between the imperative and the modal *sollen*, though we cannot fully exclude such an account.

Keywords: imperatives, root modals, bouletic modality, Maximize Presupposition, speech acts.

1. Introduction

It has been observed by various researchers that the German root modal *sollen* seems to be in complementary distribution with the imperative (Glas, 1984; Diewald, 1999; Hinterwimmer, 2013). To see this, consider the contrast between (1a) and (1b):

(1) [Maria, a doctor who works in a hospital, is drinking coffee with Lisa. Maria gets a text message from her daughter. Surprisingly, the text says:]
a. # Du **sollst** mir Morphium besorgen.
you soll me morphine get
'You are supposed to get me morphine.'
≈ 'I want you to get me morphine.'
b. Besorge mir (bitte) Morphium.
get me please morphine
'Please get me morphine.'

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In the context provided in (1), it would be most awkward for Maria's daughter to send her the message in (1a) with *sollen*. Sending the imperative message in (1b), in contrast, is fine. At the same time, it is entirely natural for Maria to utter a sentence with *sollen* in the context in (2):

(2) [Maria, a doctor in a hospital, gets a surprising text message from her daughter. Maria shows Lisa the text: Look, …]
Ich **soll** ihr Morphium besorgen.
I soll her morphine get
'I'm supposed to get her morphine.'
≈ 'She wants me to get her morphine.'

Crucially, in the case of (2), in contrast to the one in (1), uttering an imperative instead of the sentence with *sollen* would not have been an option – the imperative that comes closest is the one in (3), which has a different meaning than the sentence with *sollen* in (2). While (2) reports a request of Maria's daughter directed at Maria, the imperative in (3) can only be interpreted as a request of Maria directed at her addressee, Lisa.

(3) Besorge ihr (bitte) Morphium.
get her please morphine
'Please get her morphine.'

Similar observations have lead Glas (1984), Diewald (1999) and Hinterwimmer (2013) to propose that *sollen* is anti-performative, while the imperative is performative. In the present paper, we argue for an account along the following lines. While the imperative and *sollen* share the same basic meaning, they are subject to different constraints: The imperative is subject to an origo restriction requiring the speaker to express their preference at the utterance time for the addressee to bring about some state of affairs, and the root modal *sollen* is subject to an anti-origo restriction requiring at least one of the relevant parameters to be distinct from those of the context of utterance. Finally, we compare *sollen* and be *supposed to*, showing that they have similar, but non-identical meanings, with *be supposed to* being subject to a slightly stricter constraint than *sollen*.

The paper is structured as follows. Section 2 provides background concerning the imperative and *sollen*. Section 3 introduces the full range of data to be accounted for and presents our analysis informally. In Section 4, previous analyses are discussed and compared with our proposal. Section 5 provides the formal details of our analysis and introduces a potential alternative account. In Section 6 *sollen* is compared with *be supposed to*, and Section 7 concludes with questions for further research.

2. Background on the imperative and *sollen*

Canonical imperatives are performative: They commit speech acts like commands (as in (4a)), permissions (as in (4b)), requests (as in (4c)) and advice (as in (4d)) (Sadock, 1974; Wilson and Sperber, 1988; Schwager, 2006; Portner, 2007, 2016; Kaufmann, 2012, 2016; Condoravdi and Lauer, 2012; Oikonomou, 2016, a.o.).

(4) a. Turn down the volume!
b. Take some cookies.
c. Bring me tea, please.
d. (A: How do I get to Saarbrücken?) B: Take a regional train.

We follow Han (2000), Schwager (2006), Grosz (2009), Kaufmann (2012), Condoravdi and Lauer (2012) and Oikonomou (2016) in adopting a unified modal analysis of all uses of imperatives. For concreteness, we assume a bouletic analysis along the lines of Condoravdi and Lauer (2012) and Oikonomou (2016), according to which an imperative conveys the speaker's preference for the addressee to bring about some state of affairs. Such an analysis is at first sight in conflict with cases of disinterested advice such as B's answer in (4d): Intuitively, B does not really seem to care whether A takes the regional train to Saarbrücken. Since it is not relevant for current purposes, we will set that issue aside and tentatively follow Condoravdi and Lauer (2012) and Oikonomou (2016) in assuming that a bouletic/preference-based analysis can account for cases of disinterested advice as well.

As a starting point, we assume the strongly simplified denotation in (5) for the imperative, building on Kaufmann (2012), who assumes conditions on the interpretation of the imperative that make reference to Kaplanian contexts of utterance *c*. Its parameters relevant here are the speaker c_{Sp}, the addressee c_{Ad}, the utterance time c_T and the world where the utterance takes place c_W (Kaplan, 1989).

(5) $[\![\text{IMP}]\!]^{c,g} = \lambda P\ [c_{Sp} \text{ wants } P(c_{Ad}) \text{ at } c_T \text{ in } c_W]$

According to (5), an imperative can only express a speaker preference directed at the addressee at the utterance time in the utterance world. We assume this to be the basis for the performativity of imperatives.

Let us now turn to the modal verb *sollen*, which does not have a direct counterpart in English (its closest equivalent, *be supposed to,* will be shown to have a slightly different meaning in Section 6). *Sollen* has both root and epistemic uses. On its epistemic uses, *sollen* conveys reportative evidentiality and cannot be used in inferential contexts, as shown by the contrast between (6) and (7).

(6) [Maria tells me that when Paul proposed to her, he even went down on his knees. Later, I tell Karin:]
(Matthewson and Truckenbrodt, 2018:277)

Paul	**soll**	sogar	vor	ihr	auf	die	Knie	gegangen	sein.
Paul	soll	even	before	her	on	the	knees	gone	be

'Paul is supposed to have even gone down on his knees in front of her.'

(7) [I saw Maria going into the kitchen. The back door of the kitchen is rarely used. Nobody has said anything about Maria. I say:]
(Matthewson and Truckenbrodt, 2018: 277)

Maria	muss/# **soll**	in	der	Küche	sein.
Maria	must/soll	in	the	kitchen	be

'Maria must be in the kitchen.'

Turning to root *sollen,* we see that it can clearly be bouletic, as evidenced by (2) above, where Maria reports her daughter's preference that Maria bring the daughter morphine. In purely deontic contexts such as (8), where there is no identifiable bouletic preference-holder, in contrast, *sollen* is infelicitous. If the deontic reading comes about via an inference from the bouletic reading (cf. Glas, 1984; Condoravdi and Lauer, 2012; Lauer, 2013; Matthewson and Truckenbrodt, 2018), as in (9), *sollen* is fine, however.

(8) [Maria and Lisa are playing chess. Maria sometimes makes moves that don't follow the rules. Lisa explains each rule when this happens. Now Maria is castling and places the pieces in the wrong way. Lisa says:]
(Matthewson and Truckenbrodt, 2018: 270)
\# Du **sollst** den König neben den Turm stellen.
you soll the king next.to the rook put
'You're supposed to put the king next to the rook.'
≈ 'Someone wants you to put the king next to the rook.'

(9) [A is the boss of B at a company. A sends C to tell B on behalf of A:]
(Matthewson and Truckenbrodt, 2018: 269)
Du **sollst** diesen Bericht bis morgen um 12 Uhr schreiben.
you soll this report by tomorrow at 12 o'clock write
'You're supposed to write this report by tomorrow at noon.'
≈ 'A wants you to write this report by tomorrow at noon.'

In purely teleological contexts, *sollen* is infelicitous, as shown by (10). In disinterested advice contexts such as in (11), however, *sollen* is fine. As with the imperative, we assume that a bouletic/preference-based account works for such cases as well, following Condoravdi and Lauer's (2012) and Oikonomou's (2016) analysis of disinterested advice with the imperative.

(10) [Maria just received two important emails. She has the goal of answering important emails right away. Nobody asked her to answer her emails right away. Maria calls Peter and says:]
(Matthewson and Truckenbrodt, 2018: 273)
\# Ich **soll** noch zwei E-Mails beantworten, bevor ich nach Hause komme.
I soll still two emails answer before I to home come
'I'm supposed to still answer two emails before I come home.'
≈ 'Someone wants me to still answer two emails before I come home.'

(11) [At the train information center, L asks: How does my grandmother get to Saarbrücken by train? The official answers:]
Sie **soll** einen Regionalzug nehmen.
she soll a regional.train take
'She is supposed to take a regional train.'
≈ 'I want her to take a regional train.'

3. Evidence for the anti-performative restriction on root *sollen*

As already said in Section 1, root *sollen* cannot be used in cases where the imperative would be appropriate. As we have seen in Section 2, the imperative necessarily expresses an utterance-time desire of the speaker that the addressee brings about some state of affairs.

Consequently, *sollen* is infelicitous whenever such a desire is to be expressed. To see this, consider again the contrast between (1a) and (1b), repeated here as (12a) and (12b).

(12) [Maria, a doctor who works in a hospital, is drinking coffee with Lisa. Maria gets a text message from her daughter. Surprisingly, the text says:

a. # Du **sollst** mir Morphium besorgen.
you soll me morphine get
'You are supposed to get me morphine.'
≈ 'I want you to get me morphine.'

b. Besorge mir (bitte) Morphium.
get me please morphine
'Please get me morphine.'

In the context of (12), the imperative in (12b) expresses the speaker's (i.e. Maria's daughter's) current desire for Maria to get her morphine. As shown by the infelicity of (12a), the same desire cannot be expressed by a sentence with root *sollen*. The sentence with *sollen* in (2), in contrast, repeated here as (13), is fine, since Maria's daughter, whose desire for Maria to get her morphine it reports, is not the speaker anymore.

(13) [Maria, a doctor in a hospital, gets a surprising text message from her daughter. Maria shows Lisa the text: Look, …]
Ich **soll** ihr Morphium besorgen.
I soll her morphine get
'I'm supposed to get her morphine.'
≈ 'She wants me to get her morphine.'

To capture this difference between the imperative and root *sollen*, which otherwise, as we have seen in Section 2, have very similar bouletic meanings, we propose the denotations in (14) and (15), respectively, to be refined in Section 5. The denotation of epistemic *sollen* is provided for comparison in (16). We draw on Sode and Truckenbrodt (2018), who analyze V-to-C movement and verbal mood using an index for contexts <x,t,w> in C, a feature [±origo] on the index, where [+origo] requires identity to Kaplan's context and [-origo] requires difference from it, and two modalities (doxastic and bouletic) that relate the prejacent to the indexed context. The imperative is bouletic and [+origo]. We extend the context to a quadruple to include the addressee, and analyze root *sollen* using the same devices: it is bouletic and [-origo].

Note that we allow *sollen* to take the (overt) subject argument separately and we index its silent argument, i.e. the argument for the preference-holder. If we write the imperative in the same way (with a subject argument and an indexed attitude holder), the only difference between root *sollen* and the imperative is the presupposed origo/non-origo requirement.

(14) $$[\![\mathrm{IMP}_j]\!]^{c,g,t,w} = \lambda P \lambda y : \underset{\substack{\uparrow \\ \text{origo-requirement}}}{\underline{\langle g(j),y,t,w\rangle = c}} \,.\, [g(j) \text{ wants } P(y) \text{ at } t \text{ in } w]$$

(15) $[\![\text{root-}\textit{sollen}_j]\!]^{c,g,t,w} = \lambda P \lambda y\text{: } \underset{\substack{\uparrow \\ \text{non-origo-requirement}}}{\underline{\langle g(j),y,t,w\rangle \neq c}}\ .\ [g(j) \text{ wants } P(y) \text{ at } t \text{ in } w]$

(16) $[\![\text{epist-}\textit{sollen}_j]\!]^{c,g,t,w} = \lambda P \lambda y\text{: } g(j) \underline{\neq c_{Sp}}\ .\ [g(j) \text{ said that } P(y) \text{ before } t \text{ in } w]$

where *c* is the context of utterance consisting of the parameters $\langle c_{Sp}, c_{Ad}, c_T, c_W\rangle$, *g* is the assignment function, *t* is the time of evaluation and *w* is the world of evaluation.

Our account now makes the following predictions: First, sentences with root *sollen* should be able to express any utterance-time preferences except ones of the speaker directed at the addressee ([1→2]). Second, even speaker preferences directed at the addressee should be fine when they are not tied to the utterance time. Third, utterance-time preferences of the speaker directed at the addressee should be fine if they are not tied to the utterance world.

Let us have a detailed look at these predictions. Consider the contrasts between the infelicity of the sentence with root *sollen* and the imperative in (17) and (18): In each case, the preference to be expressed is an utterance-time preference of the speaker directed at the addressee in the utterance world, thus satisfying the presupposition of the imperative and violating the presupposition of root *sollen*.

(17) a. [Do you need anything while I'm out? Yes, …]
Du **sollst** Brötchen mitbringen.
you soll bread.rolls bring.with
'You're supposed to bring bread rolls.'
≈ 'I want you to bring bread rolls.'
b. Bring Brötchen mit.
bring bread.rolls with
'Bring bread rolls.'

(18) a. [Driving; I am giving directions.]
Du **sollst** die nächste Ausfahrt nehmen.
you soll the next exit take
'You're supposed to take the next exit.'
≈ 'I want you to take the next exit.'
b. Nimm die nächste Ausfahrt.
take the next exit
'Take the next exit.' (Hinterwimmer, 2013)

Consider next the sentences with *sollen* in (19)–(21), which are all felicitous: (19), the sentence reports an utterance-time preference of Maria, who is not the speaker, directed at the addressee ([3→2 present]), (20) expresses an utterance-time preference of the speaker directed at Peter, who is not the addressee ([1→3 present]), and (21) asks for the existence of an utterance time-preference of the addressee directed at the speaker ([2→1 present]). Consequently, the non-origo requirement (which, recall, disallows utterance-time preferences of the speaker directed at the addressee) is satisfied in all three cases.

(19) [Does anyone want me to bring them anything? Yes, Maria does.]
Du **sollst** ihr Brötchen mitbringen.
you soll her bread.rolls bring.with
'You're supposed to bring her bread rolls.'
≈ 'Maria wants you to bring her bread rolls.' [3→2 present]

(20) [What should everyone bring to the party?]
Peter **soll** Brötchen mitbringen.
Peter soll bread.rolls bring.with
'Peter is supposed to bring bread rolls.'
≈ 'I want Peter to bring bread rolls.' [1→3 present]

(21) [I'm at the bakery, calling you on the phone.]
Soll ich Brötchen mitbringen?
soll I bread.rolls bring.with
'Am I supposed to bring bread rolls?'
≈ 'Do you want me to bring bread rolls?' [2→1 present]

The sentences with root *sollen* in (22)–(24) show the felicity of three other person combinations in utterance-time preferences (holding at the world of utterance): In (22), a preference of Maria directed at the speaker ([3→1 present]), in (23) a preference of Maria (who is not the speaker) directed at Peter ([3→3 present]), and in (24) a preference of the addressee directed at Peter ([2→3 present]).

(22) [Why are you in the bakery now?]
Ich **soll** Maria Brötchen mitbringen.
I soll Maria bread.rolls bring.with
'I'm supposed to bring Maria bread rolls.'
≈ 'Maria wants me to bring her bread rolls.' [3→1 present]

(23) [Peter is going to the bakery. I give you a message for him:]
Er **soll** Maria Brötchen mitbringen.
he soll Maria bread.rolls bring.with
'He is supposed to bring Maria bread rolls.'
≈ 'Maria wants him to bring her bread rolls.' [3→3 present]

(24) [Peter is going to the bakery. I call you to ask:]
Soll Peter Brötchen mitbringen?
soll Peter bread.rolls bring.with
'Is Peter supposed to bring bread rolls?'
≈ 'Do you want Peter to bring bread rolls?' [2→3 present]

Our first prediction is upheld: Root *sollen* allows all person combinations except speaker-addressee with utterance-time preferences (holding at the utterance world).

Let us next turn to our second prediction, which is that speaker preferences directed at the addressee (in the utterance world) should be fine when they are not tied to the utterance time. As already observed by Hinterwimmer (2013), sentences with root *sollen* may report past bouletic preferences of the speaker directed at the addressee. Consequently, while the sentences in (25) (repeated from (18a)) and (26) are infelicitous because they violate the non-origo requirement, they are fine when uttered in the contexts provided in (27) and (28), respectively.

(25) [Driving; I am giving directions.]

# Du	**sollst**	die	nächste	Ausfahrt	nehmen.
you	soll	the	next	exit	take

'You're supposed to take the next exit.'
≈ 'I want you to take the next exit.'

(26) [Peter is whistling. After a while, I say to him:]

# Du	**sollst**	aufhören	zu	pfeifen.
you	soll	stop	to	whitle

'You're supposed to stop whistling.'
≈ 'I want you to stop whistling.'

(27)

Nimm	die	nächste	Ausfahrt! [no reaction…]
take	the	next	exit

Du	**sollst**	die	nächste	Ausfahrt	nehmen.
you	soll	the	next	exit	take

'Take the next exit … You're supposed to take the next exit.'
≈ 'Take the next exit! ... I want(ed) you to take the next exit.' (Hinterwimmer, 2013)

(28)

Hör auf	zu	pfeifen!	[no reaction…]
stop	to	whistle	

Du	**sollst**	aufhören	zu	pfeifen.
you	soll	stop	to	whitle

'Stop whistling! … You're supposed to stop whistling.'
≈ 'Stop whistling! … I want(ed) you to stop whistling.' (Hinterwimmer, 2013)

What is crucial is that in (27) and (28) the speaker is reminding the addressee of a preference already established in the immediate past with the preceding utterance. This allows the satisfaction of the non-origo requirement. We must also take into account that (27) and (28) employ the present tense. We follow Sauerland (2002, 2008) in the analysis of a semantically vacuous present tense that is in competition with a semantically contentful past tense. This analysis is based on a pronominal interpretation of tense. In the interpretation of the second utterance in (28), the temporal pronoun denoted by the finite tense will refer to a relevant temporal interval that includes the time of the preceding utterance and the present. Past tense can then not be used because this interval does not lie in the past, and therefore present tense is used. We assume that this is also the temporal interval t in the attitudinal anchor <x,y,t,w> of *sollen* in (28). We are thus led to the following conclusion. Where t in <x,y,t,w> stretches across a relevant point in the past and the time at which the utterance is made, it counts as different from c_T for the purpose of the non-origo requirement on <x,y,t,w>.

As a side effect, our analysis can also account for the observation that the combination of an imperative and an immediately following sentence with *sollen* signals a level of annoyance that could not have been expressed by a simple repetition of the imperative. The reason is that while the imperative just states the existence of a current preference twice, by uttering the sentence with *sollen*, the speaker also expresses that she had already articulated that preference in the past. The effect is thus similar to the one obtained by uttering the sequence in (29), which likewise sounds more annoyed than a simple repetition of the imperative:

(29) Nimm die nächste Ausfahrt! [no reaction…] Ich habe dich gebeten,
take the next exit I have you asked
die nächste Ausfahrt zu nehmen.
the next exit to take
'Take the next exit! ... I asked you to take the next exit.'

Let us now turn to the final prediction–that utterance-time preferences of the speaker directed at the addressee are fine if they are not tied to the utterance world. Unfortunately, the results are less clear. Consider the contrast between the felicitous combination of a conditional antecedent and an imperative in (30a), and the infelicitous combination of a conditional antecedent and a sentence with root *sollen* in (30b). In both cases, the sentences are to be interpreted as text messages sent by someone who considers it likely that the receiver is at the train station, but is not sure. Keep in mind that (30b) is of course felicitous if it is understood in such a way that the speaker reports someone else's desire for the addressee to bring bread rolls if she is at the train station.

(30) a. Wenn du gerade am Bahnhof bist, bring bitte Brötchen mit.
if you just at.the station are bring please bread.rolls with
'If you're at the train station right now, please bring bread rolls.'
b. # Wenn du gerade am Bahnhof bist, **sollst** du bitte Brötchen
if you just at.the station are soll you please bread.rolls
mitbringen.
bring.with
'If you're at the train station right now, you're supposed to bring bread rolls.'
≈ 'If you're at the train station right now, I want you to bring bread rolls.'

On our account, the judgments make sense if the conditional operator and the antecedent clause scope below the imperative and below *sollen*, i.e. if both sentences are understood as preferences that the speaker has in the utterance world at the utterance time, where those preferences do not directly concern the utterance world, but rather the set of worlds maximally close to the utterance world where the speaker is at the train station. It is unclear, however, why the conditional operator and the antecedent should not be able to scope above the imperative (cf. Kaufman and Schwager, 2009 and references therein) and above *sollen*, i.e. why the sentences should not be able to express utterance-time preferences that the speaker does not have in the utterance world, but rather in each member of the set of worlds maximally close to the antecedent world where the receiver of the text message is at the train station (Stalnaker, 1975; Kratzer, 1991a). We thus have to leave the behaviour of root *sollen* in conditionals open as a topic for further research and conclude that for the time being we do not have conclusive evidence for or against the third prediction of our analysis.

Our analysis also accounts for cases like (31), where the preference does not concern another individual, but rather an event.

(31) [Paul is singing *Yesterday* for his baby daughter. I ask him: Why are you doing that? He answers:]
Das **soll** das Baby beruhigen.
that soll the baby calm.down
'It's supposed to calm the baby down.'
≈ 'I want it to calm the baby down.' (Hinterwimmer, 2013)

In such cases the speaker does not want an individual, but rather an event–namely the event of him singing for his baby daughter–to have a certain property: the property of calming down his baby daughter. The external argument of root *sollen* is thus not restricted to (ordinary) individuals, but can be of the type of events as well.

Our analysis can also potentially be extended in such a way that it accounts for cases like the one in (32).

(32) [Two children are playing and pretending to be Jedi knights. Holding a broomstick painted green, one of them says to her mother]:
Das **soll** ein Lichtschwert sein.
that soll a lightsaber be
'This is supposed to be a lightsaber.'

Since the child is well aware that the broomstick can never become a lightsaber, it is intuitively not correct to say that she wants the broomstick to have the property of being a lightsaber. Rather, she wants the broomstick to be seen as if it was a lightsaber for the purposes of the game she is playing with her friend, i.e. she wants the broomstick to be a lightsaber in the fictional worlds she is 'inventing' together with her friend while they are playing together. In contrast to the cases so far, the modal base for root *sollen* is thus not identical to the doxastic modal base of root *wollen* ('want'). The latter always takes a doxastic modal base: One cannot want something which one believes to be impossible (Heim, 1992). The variant of (32) in (33) is therefore not equivalent to the original version:

(33) [Two children are playing and pretending to be Jedi knights. Holding a broomstick painted in green, one of them says to her mother]:
Ich **will**, dass das ein Lichtschwert ist.
I want that that a lightsaber is
'I want this to be a lightsaber.'

We leave a further investigation of this contrast between *wollen* and *sollen* for another occasion. For now it is sufficient that our [-origo] requirement on *sollen* is satisfied by the data in (32), both because t in <x,y,t,w> can refer to a past preference and because it is not a preference for an action by the addressee.

4. Two previous accounts of the anti-performative restriction on root *sollen*

In this section, we discuss the analyses of *sollen* proposed by Hinterwimmer (2013) and Bochnak and Csipak (2018). They both unify the anti-performativity restriction on root *sollen* with the reportative restriction on epistemic *sollen*, which is in principle a desirable result. We will show both accounts to be empirically inadequate, however.

Hinterwimmer (2013) assumes that for both epistemic and root uses of *sollen* there is a prior intentional act α whose agent *x* is distinct from the individual denoted by the subject of the clause. In all worlds where the intended result of α obtains, the prejacent proposition is true. In the case of epistemic *sollen*, the prior intentional act is an assertion, while in the case of root *sollen* the prior intentional act is a command/advice/request etc.

(34) $[\![\textit{soll}]\!] = \lambda P \lambda x \lambda w.\ [\exists e \leq_{\text{part}} w\ \exists y[\text{Agent}(y)(e) \wedge y \neq x \wedge \forall w'\ [w' \in \cap\ \text{GOAL}(y)(e) \rightarrow \exists e'\ [\neg\tau(e') < \text{NOW} \wedge P(x)(e')]]]]$,
where $\tau(e')$ is the temporal trace of e' and $\cap\ GOAL(y)(e)$ is the set of worlds where all the goals that *y* intends to achieve with *e* obtain.

According to Bochnak and Csipak (2018), who propose the denotation in (35), *sollen* is reportative in both epistemic and root uses. In both uses, *sollen* relies on a prior utterance. If the existence of such a prior act is not entailed by the common ground at the utterance time, it must be accommodated.

(35) $[\![\textit{sollen}]\!]^{c,w,t} = \lambda P \lambda x[\forall m \in t[\forall w' \in \max_{g_{m(w)}}(\cap\ f_m(w)) : P(x)(w') = 1]]$
defined only if the context *c* provides a circumstantial modal base f_m and reportative informational ordering source $g_{\alpha,m}$.

Both accounts capture the anti-performativity effects of root *sollen* quite well. We also agree that there is a partially unified restriction across both epistemic and root *sollen*: Both uses of *sollen* have closely related anti-origo restrictions (see (15) and (16)). We think that fully unifying the epistemic and root uses of *sollen* fails to capture the fact that these are distinct readings, however; that is, we think that there is a true ambiguity. To see this, consider the two sentences with *sollen* in (36) and (37). The one in (36) only has a reportative reading, and a bouletic interpretation of *sollen* would lead to a clear contradiction. In the case of (37), it is the other way round: The sentence only has a bouletic reading, and a reportative interpretation of *sollen* would be a real misinterpretation of what the speaker is saying.

(36) [The man from customer service says that our telephone is broken. I say:]
Unser Telefon **soll** kaputt sein, was ich ärgerlich finde.
our telephone soll broken be what I annoying find.
'Our telephone is supposed to be broken, which I find annoying.'
(adapted from Matthewson and Truckenbrodt, 2018: 279)

(37) [Nobody has said anything so far about what people should bring to the party, or what people will bring. I ask you: What should everyone bring?]
Peter **soll** Brötchen mitbringen.
Peter soll bread.rolls bring.with
'Peter is supposed to bring bread rolls.'
≈ 'I want Peter to bring bread rolls.'

Crucially, root *sollen* can be felicitous even if there was no prior utterance, as long as the non-origo restriction is not violated. This is the case in (37), for example, which expresses an utterance-time speaker preference directed at Peter, who is not the addressee. In (38) and (39), there is likewise no violation of the non-origo restriction since the sentences express utterance-time speaker preferences that either have no addressee at all (in the case of (38)), or are directed at a rather unspecific group (in the case of (39)).

(38) Es **soll** aufhören zu regnen.
it soll stop to rain
≈ 'I want it to stop raining.' [1→0 present]

(39) [You live in a closed community of 25 people. Your bakery, Filou, is scheduled to close. The other 24 people have all said they agree with Filou closing. You alone want it to stay open. So far, you haven't told anybody your preference, but you write a protest sign that says:]
Filou **soll** bleiben.
Filou soll stay
≈ 'I want Filou to stay.' [1→3 present]

Bochnak and Csipak's (2018) account wrongly predicts that *sollen* is infelicitous in these cases, since there is no plausible earlier utterance to be reported. Hinterwimmer's (2013) account seems to fare better, because it says that the prior intentional act need not be a speech act; It 'may even be a mental event of having an intention to bring about the respective state of affairs.' Hinterwimmer's account, however, has problems capturing the difference between these and the [1→2 present] cases, which are excluded on our account, since there doesn't seem to be a contrast between the two types of example in whether there is a prior intentional act. Hinterwimmer (2013) sketches a potential solution to this problem: Whenever the imperative can be used to state the relevant preference directly, conveying its existence indirectly via invoking a prior intentional act is dispreferred because it is less economical, i.e. there is competition between root *sollen* and the imperative. In Section 5 we will see, however, that there are arguments against a competition-based account of the distribution of *root* sollen. Additionally, the ontological status of the intentional acts assumed by Hinterwimmer (2013) is rather unclear. We therefore conclude that the account argued for in this paper–according to which root *sollen* carries a non-origo restriction–is empirically more successful than the accounts of Hinterwimmer (2013) and Bochnak and Csipak (2018). This indirectly strengthens our analysis of the imperative in terms of the Kaplanian context.

5. Formal implementation and an alternative account

The denotations of the imperative and root *sollen* stated in Section 3 as (14) and (15) are repeated here as (40) and (41), respectively. In (42) and (43), formally more precise entries are provided, which are based on Kratzer's (1981, 1991b) analysis of modal verbs in terms of quantification over the worlds in the modal base *f* that make as many propositions in the ordering source *h* true as possible. The origo/non-origo restriction is stated as a restriction on the arguments of the ordering source *h*, which we assume to be bouletic, while the modal base is doxastic. Consequently, the universal quantifier in both (42) and (43) quantifies over those worlds that are compatible with what is known at the evaluation time that make as many preferences true as possible that the contextually determined value of the free variable *j* has at the time and world of evaluation regarding the individual referred to by the subject argument of *sollen*. In the case of the imperative, it is presupposed that the arguments of the bouletic ordering source *h* are identical with the parameters of the utterance context, while in the case of root *sollen*, non-identity is required with respect to at least one parameter.

(40) $[\![\text{IMP}_j]\!]^{c,g,t,w} = \lambda P\ \lambda y : \langle g(j),y,t,w\rangle = c\ .\ [g(j) \text{ wants } P(y) \text{ at } t \text{ in } w]$

(41) $[\![\text{root-}sollen_j]\!]^{c,g,t,w} = \lambda P\ \lambda y{:}\ \langle g(j),y,t,w\rangle \neq c\ .\ [g(j) \text{ wants } P(y) \text{ at } t \text{ in } w]$

(42) $[\![\text{IMP}_j]\!]^{g,c,t,w,f,h} = \lambda P\lambda y{:}\ \langle g(j),y,t,w\rangle = c\ .\ \forall w'\ [w' \in \text{BEST}_{h(g(j),t,w)}(\cap f(g(j),w,t)) \rightarrow P(y)(t)(w')]$

(43) $[\![\text{root-}sollen_j]\!]^{c,g,t,w,f,h} = \lambda P\ \lambda y{:}\ \langle g(j),y,t,w\rangle \neq c\ .\ \forall w'\ [w' \in \text{BEST}_{h(g(j),t,w)}(\cap f(g(j),w,t)) \rightarrow P(y)(t)(w')]$

Instead of assuming the imperative and *sollen* to have the directly opposing presuppositions stated in (40)/(42) and (41)/(43), respectively, one might also assume that while both items have identical at-issue meanings (Potts, 2005), only the imperative has a genuine presupposition–namely the origo restriction. What seems to be the inverse presupposition for root *sollen* would instead be derived from the pragmatic principle *Maximize Presupposition* (Heim, 1991; Schlenker, 2005; Chemla, 2008; Sauerland 2008, a.o.). Setting aside the various differences in technical implementation, the idea shared by all versions of Maximize Presupposition that have been proposed can be stated as follows: Whenever there are two items α and β that (a) are comparable in terms of syntactic complexity, (b) have identical at-issue meanings and (c) differ with respect to their presuppositions insofar as α presupposes more than β, and α's presuppositions are satisfied in a context, a sentence containing β has to be replaced by a syntactically parallel sentence containing α.

Maximize Presupposition accounts for the infelicity of (44a) in any context, for example: Assuming that the indefinite and the definite article only differ insofar as the latter presupposes existence and uniqueness, while the former does not have any presupposition, Maximize Presupposition correctly predicts that (44a) has to be replaced by (44b), or, put differently, that the existence of the alternative in (44b) blocks the utterance of (44a).

(44) a. * A sun is shining.
b. The sun is shining.

Applying the same reasoning to an example such as (17a), repeated here as (45a), we would say that utterance of this sentence is blocked in the context provided by the existence of the alternative in (17b), repeated here as (45b), since (a) the imperative and root-*sollen* have identical at-issue meanings and (b) the origo-restriction of the imperative is satisfied.

(45) a. [Do you need anything while I'm out? Yes, …]
\# Du **sollst** Brötchen mitbringen.
you soll bread.rolls bring.with
'You're supposed to bring bread rolls.'
≈ 'I want you to bring bread rolls.'
b. Bring Brötchen mit.
bring bread.rolls with
'Bring bread rolls.'

The problem with the alternative account just sketched is that we have to assume that the two syntactically rather different structures given in schematic form in (46) are compared, contra Katzir (2007). The heads being compared would be IMP and [DECL *sollst*], both bouletic Cs, but the other considerable syntactic differences between the two structures would need to be ignored for the comparison to be successful.

(46)

Spec,CP	C		V	V
	[IMP bring$_1$]	Brötchen	mit__$_1$	
du	[DECL **sollst$_2$**]	Brötchen	mitbringen$_1$	____$_2$

Because of this problem, and because of another, more indirect argument against a competition-based account of the distribution of root *sollen* which will be discussed in Section 6, we stick with the account argued for above, according to which the imperative is subject to an origo restriction, while root-*sollen* is subject to a non-origo restriction.

6. A comparison of root *sollen* and *be supposed to*

The closest equivalent of *sollen* in English is *be supposed to* (Bochnak and Csipak, 2018). Like epistemic *sollen*, epistemic *be supposed to* is only reportative, not inferential, as shown by the contrast between (47) and (48):

(47) [M tells me that when P proposed to her, he even went down on his knee. Later, I tell K:]
P **is supposed to** have even gone down on his knee in front of her.

(48) [I saw Maria going into the kitchen. The back door of the kitchen is rarely used. Nobody has said anything about Maria. I say:] (Matthewson and Truckenbrodt, 2018:302)
Maria must/# **is supposed to** be in the kitchen.

Similarly, like root *sollen,* root *be supposed to* is good in purely bouletic contexts such as the one in (49), and bad in teleological ones like the one in (50):

(49) [M, a doctor who works in a hospital, gets a surprising text message from her daughter. M shows L the text and says: Look, …]
I **am supposed to** get her morphine. (Matthewson and Truckenbrodt, 2018:300)

(50) [Maria just received two important emails. She has the goal of answering important emails right away. Nobody asked her to answer her emails right away. Maria calls Peter and says:] (Matthewson and Truckenbrodt, 2018:301)
\# I **am supposed to** still answer two emails before I come home.

Unlike *sollen*, however, root *be supposed to* is good in purely deontic contexts as in (51):

(51) [Maria and Lisa are playing chess. Maria sometimes makes moves that don't follow the rules. Lisa explains each rule when this happens. Now Maria is castling and places the pieces in the wrong way. Lisa says:] (Matthewson and Truckenbrodt, 2018:301)
You **are supposed to** put the king next to the rook.

Crucially, *be supposed to* is subject to a similar, but slightly different non-origo restriction than root *sollen*: *be supposed to* disallows the expression of the speaker's preference at the utterance time. A representative sample of the relevant data is given in (52)–(54):

(52) [Do you need anything while I'm out? I think and decide what I want:]
You'**re supposed to** bring bread rolls.' #[1→2 present]

(53) [Why are you in the bakery now?]
I'**m supposed to** bring Maria bread rolls. [3→1 present]

(54) [Does anyone want me to bring them anything? Yes, …]
You'**re supposed to** bring Maria bread rolls. [3→2 present]

The crucial difference between *sollen* and *be supposed to* is that while *sollen* allows utterance-time speaker-preferences for anyone other than the addressee, *be supposed* to disallows *any* utterance-time speaker preferences, as shown by the contrasts between (55a) and (55b), and (56a) and (56b):

(55) a. Es **soll** aufhören zu regnen.
it soll stop to rain
b. # It'**s supposed to** stop raining. [1→0 present]

(56) [You live in a closed community of 25 people. Your bakery, Filou, is scheduled to close. The other 24 people have all said they agree with Filou closing. You alone want it to stay open. So far, you haven't told anybody your preference, but you write a protest sign that says:]
a. Filou **soll** bleiben.
Filou soll stay
b. # Filou **is supposed to** stay. [1→3 present]

We therefore propose the denotation in (57) for bouletic *be supposed to*, according to which the non-origo restriction is not specific to the addressee.

(57) $[\![$bouletic-*be-supposed-to$_j$*$]\!]^{c,g,t,w}$ = λP λy: <g(j),t,w> ≠ <c_{Sp}, c_T, c_W> . [g(j) wants P(y) at t in w]

Significantly, in contrast to *sollen*, *be supposed to* is **not** in complementary distribution with the imperative since it is infelicitous in contexts where the imperative is also bad: It is at least odd to say *Stop*! to the rain or *Stay*! to Filou, yet *be supposed to* is still ruled out there. *Be supposed to* is also bad in more ordinary [1→3] cases where the imperative is not licensed: (58), for example is acceptable only if there was a pre-existing preference for Peter to bring bread rolls (i.e. if the time parameter is non-origo).

(58) [What should everyone bring to the party?]
Peter **is supposed to** bring bread rolls. [1→3 present]

Thus, *be supposed to* seems to have a wired-in non-origo restriction. This makes it plausible that *sollen* has a slightly different non-origo restriction: It only disallows [1→2 present], but allows the expression of utterance-time speaker preferences directed at other persons.

7. Conclusion

In this paper, we have proposed an analysis of the imperative and the German root modal *sollen* according to which both items have the same bouletic meaning, but are subject to different presuppositions: The quadruple <x,y,t,w> of the bouletic attitude holder x, the agent y of the prejacent, the time and the world of the preference, must be identical to the utterance context <c_{Sp}, c_{Ad}, c_{T}, c_{W}> in the imperative, and must be different from the utterance context with root *sollen*. From these requirements, the performativity of the imperative and the anti-performativity of root-*sollen*, as well as their complementary distribution, can be derived.

We have shown that the proposed analysis has empirical advantages over previous accounts by Hinterwimmer (2013) and Bochnak and Csipak (2018), which assume a uniform semantics for both root and epistemic *sollen*. Finally, we have compared *sollen* to its closest equivalent in English, *be supposed to*, showing that the two are subject to similar, but slightly different constraints: In contrast to root *sollen*, which only disallows utterance-time speaker preferences when they are directed at the addressee, *be supposed* to disallows utterance-time speaker preferences altogether. In contrast to root *sollen*, *be supposed to* is thus not in complementary distribution with the imperative. Consequently, its distribution cannot be derived from the assumption that the imperative is subject to an origo-restriction in combination with Maximize Presupposition. This, together with inherent problems concerning the non-parallelism of the compared alternatives, has led us to the conclusion that our analysis is to be preferred to a conceivable alternative account of the distribution of root *sollen* in terms of Maximize Presupposition.

We end this paper by mentioning a potential problem for our analysis that we do not have fully satisfactory answers to at present, but which we are planning to take up in future research.[2] Recall from Section 3 that in a question like (21), repeated here as (59), *sollen* is correctly predicted to be felicitous by our account because the speaker is asking about a preference of the addressee directed at the speaker. The problem now is that the addressee can felicitously answer that question as in (60), which expresses an utterance-time speaker preference for the addressee and therefore violates the non-origo restriction.

(59) [I'm at the bakery, calling you on the phone.]
Soll ich Brötchen mitbringen?
soll I bread.rolls bring.with
'Am I supposed to bring bread rolls?'
≈ 'Do you want me to bring bread rolls?' [2→1 present]

(60) Ja, du **sollst** Brötchen mitbringen
yes, you soll bread.rolls bring.with
'Yes, you're supposed to bring bread rolls.'
≈ 'Yes, I want you to bring bread rolls.' [1→2 present]

A potential solution would be to say that by uttering *ja* 'yes' first, the speaker already indicates the existence of the preference asked for at the utterance time. By the time at which she continues with *Du sollst Brötchen mitbringen*, that sentence therefore automatically expresses a past preference that extends to the present, similarly to cases such as (27) and

[2] We are grateful to Tue Trinh for pointing this problem out to us.

(28) discussed in Section 3 above. While the presence of *ja* 'yes' is preferred, it is also preferred in other answers to *yes-no* questions that repeat the content of the question, so the issue is not easy to test and we leave it open here.

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Expected utility and intentional action: The semantics of *try* [1]

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Abstract. This paper explores a new semantics for *try*. Sharvit's (2003) and Grano's (2017a) event semantics are evaluated in light of novel data pertaining to the entailments that *try* licenses. A new account is proposed which incorporates information about an agent's expected utilities (Jeffrey, 1965). This new account, building on the insights of the previous ones, predicts *try*'s peculiar entailment properties. Further data is presented which lends itself to this new approach.

Keywords: aspect, event structure, the progressive.

1. Introduction

Recent work on the predicate *try* has used as its starting point the aspectual properties it shares with the progressive (Grano, 2011; Sharvit, 2003). *Try* appears sensitive to verb classes in a way that is much like the progressive. Both tend to go well with activity and accomplishment predicates, (1) and (2), but not as well with many achievement predicates (3) (Vendler, 1957; Dowty, 1979).

(1) a. Sam was running.
    b. Sam tried to run.

(2) a. Sam was building a house.
    b. Sam tried to build a house.

(3) a. ? Mary is noticing a picture.
    b. ? Mary tried to notice a picture. (Sharvit, 2003)

In light of this observation a natural hypothesis would be to suppose that *try* and the progressive share similar semantic properties. Although this idea has some plausibility there are three features of *try* that distinguish it from the progressive and suggest that this connection may not be too tight. First, *try* differs from the progressive in terms of what the speaker believes is a likely development of the event being described. Second, *try* differs from the progressive in that *try* can only combine with predicates that describe an event that the agent 'can control'. Third, while *try* is sensitive to a 'means-end' entailment constraint the progressive is not.

It is often noted that the progressive is sensitive to what may be called a 'realism constraint' (Dowty, 1979; Portner, 1998). In other words, in out of the blue contexts speakers typically judge sentences under the progressive as false unless it could be reasonably inferred that the event described could be realized under 'normal conditions'. But *try* does not appear to impose this constraint.

(4) a. ✓Mary was crossing the street (but the bus hit her before she could make it).
    b. ✓Mary tried to cross the street (but the bus hit her before she could make it).

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(5) a. ✗Mary was defeating the Roman army (but was overwhelmed).
b. ✓Mary tried to defeat the Roman army (but was overwhelmed).

In (4a) we would think that if conditions were normal and Mary was uninterrupted by the bus accident the crossing-the-street event would have run to completion. But under typical conditions speakers tend not to judge that for (5a), even with no event external interruptions, the event described would run to completion. Compare with (4b, 5b). The events described as attempted are the same as under the progressive but speakers will typically judge that, in the same context, (4b,5b) are true. Hence, *try* is not subject to the same realism constraint as the progressive. The event described under *try* does not require that factors internal to the event itself make it likely that it will run to completion.[2] What does constrain *try* though is if the agent believes that the action they are performing is possible. This can be observed by the felt infelicity of (6).

(6) ? Mary tried to defeat the Roman army even though she didn't believe that she could.

It should be noted that this constraint on *try* is fairly weak. The agent need not believe that the event she is trying to bring about is likely and can, in fact, be highly unlikely.

(7) Mary tried to swim the Pacific even though she knew she almost certainly would perish.

In contrast to *try* where an agent (minimally) has to believe that they might be bringing about some event, events under the progressive do not require the agent to believe that they are bringing them about under all descriptions of that event (Davidson, 1963). In the context below both (8a) and (8b) are true descriptions of the event but it is only the latter that Don believed that he did. Therefore, while (8c) is true (8d) is not.

(8) SCENARIO: Don walks into the bathroom and flips the light switch.
a. Don was alerting the burglar (although he didn't know it).
b. Don was illuminating the bathroom.
c. Don tried to illuminate the bathroom.
d. Don tried to alert the burglar.

Another feature of *try* that pertains to the agent's doxastic state is that the event that the agent is trying to bring about can be impossible according to the speaker's beliefs as long as the agent nevertheless believes that the event is possible. (Sharvit, 2003, her (75a,b)):

(9) a. John tried squaring the circle.
b. ? John was squaring the circle.

The first cluster of differences between *try* and the progressive then can be summarized as follows. While events in the progressive are subject to a 'realism constraint' events under *try* are

[2]There is some difficulty pinning down which factors are internal versus external to an event. For purposes here, it may be helpful to think factors internal to events are factors that are a part of the event itself, as opposed to factors which are not. Which factors constitute being 'a part of an event' I will assume can be settled by context.

subject to a 'possible-according-to-the-agent constraint'. Furthermore, under the progressive the agent is not required to know that they are bringing about the event while under *try* agent's may only bring about events that they, in fact, believe they are bringing about.

A second feature is that *try* appears to only be able to combine with predicates that describe an event that is under the control of the subject. Speakers typically judge *try* sentences that describe an involuntary event such as *tripping, getting sick,* et cetera as anomalous. In contrast, speaker's report no such anomalousness under the progressive.

(10) a. Sam was tripping.
 b. ? Sam tried to trip.

(11) a. Sam was getting sick.
 b. ? Sam tried to get sick.

It should be noted that although speaker's judge (10b) and (11b) as anomalous when describing a tripping or sickening event that is already in progress the anomalousness disappears in contexts where the event is not itself underway but at a prior time when the agent is making preparations to increase the likelihood of that event. For example, (11b) is judged as acceptable in contexts where Sam is drinking a glass of expired milk in order to increase her likelihood of getting food poisoning.

The final main feature of *try* is that it appears to be sensitive to a 'means-ends' entailment pattern while the progressive shows no such sensitivity. If an agent has some event ϕ as their end such that the agent believes she *tried to* ϕ, then speakers tend to judge that whatever necessary means ψ to ϕ*-ing* that the agent is aware of, the agent *tried to* ψ as well. Crucially, however, this does not extend to all side-effects or necessary outcomes of ϕ*-ing*.

(12) SHOE SCENARIO: Sam is about to take part in the race. She wants nothing more than to win. But she knows that no matter how fast she runs she will not beat her competitor unless she wears he lucky shoes. Unfortunately they are old and only have a few more runs left in them. Sam judges that although she wishes she could run with them and not have them worn down this option is foreclosed. Alas, this is the cost of winning.
 a. Sam tried to win the race.
 b. $\Rightarrow$ MEANS: Sam tried to run fast.
 c. $\not\Rightarrow$ SIDE-EFFECT: Sam tried to wear down her shoes.

In (12) the entailment from (12a) to (12b) is easily felt. Given that Sam is trying to achieve the end of winning the race, she is also trying to take the necessary means of running fast. However, even if it is a necessary side-effect of winning the race that her shoes wear down and furthermore, she is aware of and accepts this side-effect, it does not seem that the entailment from (12a) to (12c) goes through. Meanwhile under the progressive both entailments seem fine.

(13) a. Sam was winning the race.
 b. $\Rightarrow$ Sam was running fast.
 c. $\Rightarrow$ Sam was wearing down her shoes.

While *try* bears some similarity to the progressive it has a number of distinctive properties. The goal of this paper is to develop an account that can capture these properties. §2 considers existing accounts of *try* and where those accounts still leave some gaps. §3 provides a new account of *try*. I argue that the right kind of explanation is one that puts the agent's doxastic states and preferences at center stage. A natural way to capture this feature is by incorporating expected utility and probabilistic information into the semantic analysis. By doing so a unified and conceptually economical account of *try*'s is provided.

2. Existing Theories

Two recent accounts of *try* are the proposals in Sharvit (2003) and Grano (2011, 2017a). Both accounts, although differing in formal implementation, are guided by the following idea. For an agent α to *try to* ϕ is for there to be some event *e* that runs to completion in all possible continuations of *e* according to α.

This idea is motivated by two data points regarding *try*. The first is that for α *tried to* ϕ to be true, there must be some event that α brought about. This can be contrasted with other predicates such as *want*. Compare (Grano, 2017a, his (20, 21)):

(14) a. ? John tried to open the door, but he didn't do anything about it.
b. John wanted to open the door, but he didn't do anything about it.

While in (14b) there does not seem to be anything contradictory about having a standing want to open a door but failing to do anything there does seem to be something odd about trying to do something but taking no action towards doing so as in (14a). It should be noted, however, there is some plasticity with what may count as an action that the individual takes. As observed by Grano, the action can (at least in some contexts) be the minimal action of forming an intention to do what one is trying to bring about (Grano, 2011, his (18, 19)).

(15) a. ? John was unknowingly paralyzed and was raising his arm.
b. John was unknowingly paralyzed and tried to raise his arm.

(16) a. ? John was cutting a tomato with his mind.
b. John tried to cut a tomato with his mind.

The second and related feature of *try* is that the agent must have a pro-attitude towards what they are trying to do. While both Grano (2011, 2017a, b) and Sharvit (2003) agree on this point each account cashes it out in slightly different ways. Grano takes this component to be that if the agent tried to ϕ, then the agent must have had a standing intention to ϕ. Sharvit argues that if an agent tried to ϕ, then the agent must have a desire to bring about ϕ. Although this difference will bear on which formal analysis each adopts for now we may note that in either case it appears that the agent must have some sort of pro-attitude towards the event being brought about.

(17) ? John tried to open the door, but he had no intention of opening the door.

(18) ? John tried to open the door, but he did not want to open the door.

It should be noted that some speakers attest that (18) can be given a reading where it does not sound contradictory. Namely one where John for whatever reason does not want to open the door, but there is some stronger contravening desire that is moving him to open the door. But the acceptability of (18) shifts under a reading where John does not have a mere standing desire to open the door but rather a motivating desire or what has sometimes been called an 'effective preference' (Condoravdi and Lauer, Condoravdi and Lauer; **?**). Under this reading (18) is considerably degraded.

2.1. Sharvit's Continuation Branch Account

Sharvit's proposal is a continuation-branch style semantics in the spirit of Landman (1992). The proposal is that like the progressive, *try* quantifies over worlds where the event that the agent is trying to bring about runs to completion. Unlike the progressive though, the worlds considered are not restricted to 'realistic' or normal continuations. These worlds are the subject's 'success worlds' or worlds that, according to the agent, are preferable outcomes.[3]

The details of the interpretation are as follows. Define a *realistic continuation branch* of an event e relative to w be a sequence of event-world pairs $\langle\langle e_1, w_1\rangle, \ldots, \langle e_n, w_n\rangle\rangle$ where the following conditions hold (Sharvit, 2003, p.412-413):

(19) a. $w_1 = w$ and $e_1 = e$ and for any m, e_m is an event in w_m;

b. if $n > 1$, then for any m where $n > m \geq 1$: (i) e_m is a proper stage of e_{m+1} and (ii) there is an event in $w_m(\textsc{max}\text{-}w_m)$ which is the maximal event in w_m of which e is a proper stage;

c. for any m such that $n > m \geq 1$, w_{m+1} is a *reasonable option* for e in w, and (i) if e_m is $\textsc{max}\text{-}w_m$, then w_{m+1} is a world maximally similar to w_m where whatever interrupts $\textsc{max}\text{-}w_m$ in w_m does not interrupt it in w_{m+1}, and (ii) if e_m is not $\textsc{max}\text{-}w_m$, then $w_{m+1} = w_m$;

d. either there is no $\textsc{max}\text{-}w_n$, or: (i) $e_n = \textsc{Max}\text{-}w_n$ and (ii) there is no closest world to w_n that has an event of which e_n is a proper stage that is a reasonable option for e in w.[4]

With the definition of realistic continuation branch, we then have the following denotation for *try* (Sharvit, 2003, p. 420-421):

(20) For any property of events P, individual α, world w, and event e, $e \in \textsc{Try}(w)(P)(\alpha)$, if and only if,

a. e is an event in w;

b. there is a (possibly non-realistic) continuation branch C of e relative to w (sufficiently similar to any realistic continuation branch of e relative to w) such that there is an event-world pair $\langle e*, w*\rangle$ in C such that $e* \in P(w*)$;

[3]The notion of 'success worlds' is following Heim (1992).

[4]The 'stage of' relation is a relation between two events where for e to be a stage of e' is for e to be an event which is a less developed version of e' (Landman, 1992). Additionally, for one world-event pair: w, e to be a 'reasonable option' for another: w', e' is for there to have been a good chance that the event e in w would have continued as e' did in w' based on factors internal to e in w.

c. for every w' compatible with what α believes in w: any world w'' maximally similar to w' such that there is a (possibly non-realistic) continuation branch C' of e relative to w'' (sufficiently similar to any realistic continuation branch of e relative to w'') and an event-world pair $\langle e*, w*\rangle$ in C' such that $e* \in P(w*)$ is more successful to α in w relative to e than any w'' maximally similar to w' where there is no such continuation branch C'.

The guiding idea is that 'α *tried to* ϕ' if there is some e (in w) brought about by α and according to α there is some doxastic alternative w', such that, e runs to completion in w' and w' is among the worlds that α wants to bring about.

This semantics secures a number of our desiderata. First, condition (20a) requires that there be an e in w such that it is a stage of the potentially completed event. This captures the point that *try* requires that there be something that the agent is doing at the time of evaluation and predicts the infelicity of (14a). Second, since in (20c) the worlds being quantified over are 'success worlds', the infelicity of (17,18) is predicted as the worlds where e runs to completion have to be preferable worlds to the agent. Third, the insensitivity to realism is also secured since the worlds are doxastic alternatives for α that she believes are possible continuations of e.

2.2. Grano's Intention Account

Although Sharvit's semantics capture a number of the features of *try* it falls to predict sentences such as (15b,16b) where the agent tries to ϕ but due to intervening factors does not initiate the event. Grano's (2017a) account while maintaining the core of Sharvit's insights remedy this issue.

On this account *try* quantifies over *intention worlds* or worlds that are compatible with the agent's intentions to act. Following Stephenson (2010), define INT as a function from individuals α and worlds w to sets of worlds compatible with α's intentions in w. An agent tries to ϕ then, if there is some event e' in all of the agent's intention worlds that is a further stage of the initial event e in w where: $e \prec e'$. [5] The innovation is that since intentions are mental events and what makes an action an intentional one is that it has as its initial stage an intention it follows that if an agent tries to ϕ, then that event has minimally the initial stage: intending-to-ϕ. Hence, cases like (15b,16b) where there is the mental event of intending-to-bring-about-ϕ but no further progression in w are predicted. The proposed entry for *try* is: (Grano, 2017a, his (42)).

(21) $\textsc{Try}(P)(x)(e)(w)$, is defined only if,
  a. $\forall y \forall e' \forall w' [P(y)(e')(w') \rightarrow Ag(e', y)$ in w'
  b. Where defined, $\textsc{Try}(P)(x)(e)(w) = 1$, if and only if, $[Ag(e,x) \wedge \forall w' \in \textsc{Int}_{\alpha,w}$: $\exists e'[e \prec e' \wedge P(x)(e')(w')]]$

(21) overcomes the issue of intended but unrealized trying events. Additionally, the anomalousness of (10b, 11b) is predicted.

[5] '$\prec$' denotes the 'stage of' relation.

(10b) ? Sam tried to trip.

(11b) ? Sam tried to get sick.

What restricts which predicates can combine with *try* is the definedness condition on *try*. Specially that the only predicates that can combine with *try* are those with *agent* role which related the agent x to event e that x is intuitively trying to bring about. Since (10b,11b) do not have have an *agent* role, these two get ruled out. Additionally, cases like (22) are blocked (2011, his (14)):

(22) * It tried to rain last night.

Although this new account does explain some features of *try*, both Grano's and Sharvit's account do not predict the 'means-end' entailment pattern associated with *try*. Return to SHOE SCENARIO:

(12) SHOE SCENARIO: Sam is about to take part in the race. She wants nothing more than to win. But she knows that no matter how fast she runs she will not beat her competitor unless she wears her lucky shoes. Unfortunately they are old and only have a few more runs left in them. Sam judges that although she wishes she could run with them and not have them worn down this option is foreclosed. Alas, this is the cost of winning.

a. Sam tried to win the race.

b. $\Rightarrow$ MEANS: Sam tried to run fast.

c. $\not\Rightarrow$ SIDE-EFFECT: Sam tried to wear down her shoes.

Both Sharvit's and Grano's accounts predicts that (12a) entails both (12b) and (12c). Consider first Sharvit's continuation-branch semantics. Assume that in w (12a) is true. If (12a) is true, then there exists a continuation branch C such that there exists a world w' where Sam wins the race. But as stipulated all win-the-race worlds that Sam holds possible are also wear-down-her-shoes worlds. In other words, Sam believes that every world where she wins, she wears down her shoes. Therefore, if (12a) is true in w, then so must (12c) be as well.

Grano's account has a similar issue. Assume that (12a) is true. If (12a) is true, then there is an event e in w such that for all worlds $v \in$ INT, there is an event e' where $e \prec e'$ and e' is an event of Sam winning the race. But assuming that all those worlds are also wear-down-her-shoes worlds we run into a similar problem. So, if (12a) is true in w, then so must be (12c) since the worlds in INT are a subset of Sam's doxastic alternatives.

The problem in both accounts is that according to their semantics *try* validates the following:

(23) If $[\![\alpha \textit{ try to } \phi]\!] = 1$ and α believes that $\phi \subseteq \psi$, then $[\![\alpha \textit{ try to } \psi]\!] = 1$.

Since both accounts validate (23), they predict that *try* should validate inferences that are upward entailing.[6] This is undesirable under the assumption that one of the features of *try* is that the agent has a pro-attitude—e.g. an effective preference, to bring about what they are trying

[6]Where upward entailment, in the relevant sense, can be defined as a generalized version of the previous validity in (23): An operator O is upward entailing, if and only if, $[\![O\phi]\!] = 1$ and $[\![\phi]\!] \subseteq [\![\psi]\!]$, then $[\![O\psi]\!] = 1$.

to do. It is an often observed fact (Asher, 1987; Heim, 1992; Levinson, 2003) that desiderative predicates are not upward entailing. Asher (1987) gives the example of John, who while wanting to take a trip on the Concord if offered for free, would not want to take one generally speaking (as it is too expensive). So, the entailment is blocked.[7]

(24) John wants a free trip on the Concord.
$\not\Rightarrow$ John wants a trip on the Concord.

If *try* does in fact have a desiderative element to it, then we should also should not see upward entailment. The entailment pattern in (12) suggests that this is the case but both proposals appear to validate it.

In summary while both Sharvit and Grano's accounts capture a number of the features of *try* neither explains the felt means-end entailment pattern and the distinction between necessary means and side-effects.

3. A New Approach: Adding Expected Utility

What is needed is an account of *try* that blocks the upward entailment property but preserves the means-end entailment relation. In other works (Levinson, 2003; Lassiter, 2017) expected utilities have been introduced to model the entailment patterns of desire reports and deontic modals both of which lack the upward entailment property. What I suggest is that *try* with its desiderative component is a natural candidate for this kind of analysis.

Formally we interpret *try* relative to a decision model $\mathfrak{D}$ and a context c. A decision model is an ordered 7-tuple: $\mathfrak{D} := \langle \alpha, A, W, Pr, \mu, \mathfrak{C}, V\rangle$. As before, α is an agent, and A is the set of doxastic alternatives for α such that $A \subseteq W$ (where W is the set of possible worlds).

The models are enriched with the following additional parameters. Lower case Greek letters ϕ, ψ are propositional variables which denote sets of worlds in A. Pr is a probability measure on sets of worlds in A, such that $Pr : \phi \mapsto [0,1]$ which satisfies the following properties:

(25) a. **Normalization:** $Pr(A) = 1$;
b. **Non-negativity:** $Pr(\phi) \geq 0$;
c. **Finite Additivity:** $Pr(\phi \vee \psi) = Pr(\phi) + Pr(\psi)$, whenever ϕ and ψ are disjoint;

This measure captures the subjective credence that α holds towards ϕ obtaining. The utility function $\mu : w \mapsto \mathbb{R}$ measures the subjective goodness of each world according to α (in c).

The parameter $\mathfrak{C}$ represents the set of actions $\Delta_1, \Delta_2, \ldots \Delta_n$ that α may choose in c. The action set is defined as follows $\mathfrak{C} := \{\Delta | \Delta \text{ is an action available to } \alpha \text{ in } c\}$. Formally, we can think of a choice as a partition on A. If α *chooses* Δ, then $[\![\delta]\!]^{c,\mathfrak{D}} = 1$ (where 'δ' is a name for the action Δ).[8] This gives us, relative to a choice Δ, a partition where the action is performed and where it is not. Depending on which action is performed, there will be different partitions that divide A into worlds where that action is performed and where it is not.

[7]von Fintel (1999) provides a solution to the entailment problem by arguing that while *want* is upward entailing there is a shifting of contextual parameters which explains the effects observed in examples like (24). However, it is unlikely that this solution will work for *try*.

[8]For discussion and implementations of *choices*: Cariani et al. (2013) and MacFarlane (2014).

The expected utility ($\mathbb{EU}$) of a world is computed according to standard expected utility theory (Jeffrey, 1965). The probability an agent assigns to a proposition ϕ is the sum of the probabilities of the worlds where ϕ. The goodness of a proposition ϕ is the weighted average of the goodness of each world where ϕ is true.

(26) $\mathbb{EU}(\phi) = \sum\limits_{w \in \phi \cap A} \mu(w) \times Pr(\{w\}|\phi \cap A)$

(26) gives for any proposition ϕ a determinate expected utility according α of that proposition obtaining relative to what the agent believes is possible.[9] Finally, there is the valuation function $V : [\![\phi]\!] \mapsto \{1,0\}$. Putting it all together, *try* takes takes a subject α and a prejacent ϕ:

(27) $[\![\text{TRY}(\phi)(\alpha)]\!]^{c,\mathfrak{D}} = 1$, if and only if,
  a. $\exists\Delta$ such that $\Delta \in \mathfrak{C}$ and $[\![\delta]\!]^{c,\mathfrak{D}} = 1$;
  b. $Pr(\phi|\Delta) > Pr(\phi|\neg\Delta)$;
  c. $\mathbb{EU}(\phi) > \mathbb{EU}(\neg\phi)$.

The intuition behind (27) is that α *tried to* ϕ, if and only if, there is: (i) some action Δ that α did, such that (ii) doing Δ raises the probability of ϕ, and (iii) the expected utility of ϕ is sufficiently high such that it is worth trying to bring about.[10] In other words the worlds where the agent does something Δ to bring about ϕ are more likely 'better' worlds than worlds where the agent does not do Δ.

Another way to capture this intuition is that when an agent *tries to* ϕ the agent, speaking metaphorically, partitions possible future states of the world into ones where she did do something to bring about ϕ and worlds where she did not. If taking some action makes it more likely that she will be in a world that she prefers (ϕ-worlds) compared to worlds where she takes no such action($\neg\phi$-worlds), then she *tries to* ϕ.

3.1. Putting Expected Utilities To Work

An expected utility account can, or so I argue, capture the three main features associated with *try* initially discussed.

First, the expected utility semantics can distinguish between means-end entailments and necessary side-effects. Consider again (12), we may assume that Sam's running (**run**) raises both the probability of winning the race (**win**) and wearing down her shoes (**shoes**): $Pr(\textbf{win}|\textbf{run}) > Pr(\textbf{win}|\neg\textbf{run})$ and $Pr(\textbf{shoes}|\textbf{run}) > Pr(\textbf{shoes}|\neg\textbf{run})$.[11] As described we also know that the *only* way she can win is if she wears down her shoes: $\textbf{win} \subseteq \textbf{shoes}$. We may assume that in Sam's case, despite the badness of wearing down her shoes, the goodness of winning plus

[9]Restricting the domain of worlds, following Lassiter (2017), ensures that we can screen off worlds where ϕ but are not relevant for evaluating the expected utility of decision in question. For simplicity the relevant domain restriction is doxastic alternatives (A) for the decision maker α.

[10]Probability raising may also be regarded as a way to formally capture the idea of a causal connection between two events (Glynn, 2011).

[11]Note boldface denotes sets of worlds, which is the interpretation of the sentence in question. For example 'win the race' is interpreted as **win** which denotes the set of worlds where she wins.

the probability boost of wearing the shoes for the race means that: $\mathbb{EU}(\textbf{win}) > \mathbb{EU}(\neg\textbf{win})$. Therefore, she tried to win the race by running (with her shoes).

But when we look at the expected utilities for wearing down her shoes the picture is different. While the expected goodness of winning the race for Sam was sufficiently high such that she tried to win, the expected goodness of wearing down her shoes, in general, is not that high. While there is only one way for her to win— running with her lucky shoes, there are many ways for her to wear down her shoes that do not involve winning a race. Therefore, **shoes** will contain many worlds where her shoes wear down but there is no winning. Sam would assign a fairly high negative utility to these worlds since wearing down her shoes is not something that she desires. In comparison, the set of worlds in $\neg$ **shoes** will include all the worlds where she is not worse off shoe-wise because she didn't bother to try to wear them down. Relative to this decision of whether to wear down her shoes or not, the expected utilities of either decision will be such that: $\mathbb{EU}(\textbf{shoes}) < \mathbb{EU}(\neg\textbf{shoes})$. Therefore, she did not try to wear down her shoes.

The key point is when Sam is making the decision whether to try to win or not she needs to factor in that she will wear down her shoes. But crucially, this decision is distinct from deciding to wear down her shoes, generally speaking. While Sam wearing down her shoes is a side-effect of winning the race it is not, so to speak, the main goal of the action. If the goal was to wear down her shoes, then $\mathbb{EU}(\textbf{shoes})$ which is the expected utility of all worlds where she does something to wear them down, should be higher than $\mathbb{EU}(\neg\textbf{shoes})$. But in the scenario in (12) this is not so.

An expected utility-based account also predicts that an agent can only *try to* ϕ if $\phi - ing$ is something that is under the agent's control. An additional feature is that this control can be very minimal. The only condition is that the agent must be able to perform some action that raises the probability of ϕ per condition (27b).

(28) BOMB SCENARIO: Sam is in front of a bomb. She needs to defuse it or it will go off. There are ten wires and if she does not clip the correct one the bomb will detonate. She clips the red one. The bomb defuses. Whew.
   a. Sam tried to defuse the bomb.

Assume that in (28) Sam prefers a world where the bomb does not detonate to one where it does and that she knows that if she does nothing it will surely go off while if she clips one of the wires at random there is a chance that it will not. In other words: $Pr(\textbf{defuse}|\textbf{clip}) > Pr(\textbf{defuse}|\neg\textbf{clip})$. Since there is an available action Δ_{clip} that Sam can and does perform, the semantics makes the right prediction in (28).

Compare with the previous accounts for *try* which were tied to evaluating in worlds that the agent believed were likely outcomes of their action. In (28) we may think that Sam does not believe that her action will likely lead to defusing the bomb and will probably cause detonation. If this is the case, then the previous accounts will again predict that (28a) is false, since in all worlds that Sam thinks are likely continuations of her action of clipping, she does not defuse.

An expected utility account also gets correct predictions for a related feature. This is that *try* cannot combine with predicates that describe an event that the agent cannot influence.

(29) BACTERIA SCENARIO: Accidentally, Sam spilled a petri dish of bacteria all over herself and will certainly get the illness. She welcomes this sickness as she will get the next month off from her awful job.

a. ? Sam tried to get sick.

The felt infelicity of (29) in this scenario can be explained by the fact that there is nothing Sam could do at this time to raise the probability of her sickness. Assume there is the bacteria B causing here sickness K and at some later time there is some means M she may take to get sick. But if sickness is inevitable, then $Pr(K|M) = Pr(K|\neg M) = Pr(K|M \wedge B) = Pr(K|\neg M \wedge B)$, and there is no probability raising. Hence the infelicity.

Note though that (29a) can be repaired in other contexts. For example, imagine that earlier the night before Sam drank a carton of spoiled milk in an effort to induce sickness the next morning. We can explain why (29a) is better here. Here the salient means is her drinking sour milk which *does* raise the probability of getting sick (as compared to avoiding the milk). In this context, we get this prediction right as well.

This kind of shift can be observed in other contexts. A canonical situation where an agent lacks control of the outcome is in lottery type situations. That is to say in non-defective situations agents typically have no control over the outcome of random processes like lotteries. Despite this fact (30) strike most as completely acceptable:

(30) Sam tried to pick the winning number.

Assuming that in (30) Sam is selecting the ticket before the draw, it is not settled what the winning number is. However, the fact that she picked any of the available numbers raises the probability that she will have picked the winning number (as opposed to not picking any number at all). Assume that in this scenario picking ticket T is the relevant action Δ, such that, picking T partitions Sam's doxastic space into T and $\neg T$ worlds. Zooming in on the T ones we have worlds where the number on T is drawn and worlds where it is not (D and $\neg D$) Presumably, the D worlds in the T partition are the ones where she picked the winning ticket.

One might think that the expected utility semantics would not predict that (30), in this context, is true. This is because condition (27b) ensures an agent can only *try to* ϕ if the agent performs an action Δ such that: $Pr(\phi|\Delta) > Pr(\phi|\neg\Delta)$. The action in question here is selecting T which partitions Sam's worlds. Assume that there are some $\neg T$ worlds where the same number is drawn in the previous scenario such that we have the set of winning number and no ticket bought worlds: $\neg T \cap D$. But under the assumption that the probability of the winning number D being drawn is causally independent of someone selecting that number, then it seems that Sam's action of selecting T does not raise the probability of it being a D world, thus not the probability raising condition in (ii).

This issue is alleviated when one considers the event described: *picking the winning ticket*. It is important to note that in this scenario Sam is not trying to select some number n such that n will be the winning number at a latter time and she knows that n will be that number, but rather she is trying to select a ticket such that it opens up the possibility that n could be the winning number. In contrast, if she did not select any ticket at all, then she could not have had the winning number as she didn't play to begin with.

If the scenario is described in this way then there is probability raising as expected. Namely, the probability of *picking the winning number* conditional on *picking a ticket* raises from $Pr = 0$ to $Pr = 1/n$ (where n is the number of tickets).

Finally, an expected utility semantics can explain why *try* does not combine well with all achievements. In (31) *try* does not go well with either *notice* or *realize* but in (32) it does with *capture* and *find*.

(31) a. ? Mary tried to notice a picture.
b. ? Mary tried to realize that the oven was on.

(32) a. Mary tried to capture a mouse.
b. Mary tried to find a pen.

The first pair (31) are achievements which describe an eventuality that is a change in mental state. For Mary to *notice a picture* is, in part, for Mary to go from a state of not being aware there is a picture to being aware of that picture. For Mary to try to notice a picture would then require that there is some action Δ that she can do such that: $Pr(\textbf{notice}|\Delta) > Pr(\textbf{notice}|\neg\Delta)$. But it does not seem that there is anything she can do to raise the probability of noticing something under the assumption that to notice x is to come to believe that there is an x. This is because the assignment of probabilities, where she notices x conditional on doing Δ versus $\neg\Delta$, are measures on subsets of her doxastic space: A. However, in all of these worlds, they will be by definition worlds where there is an x such that she does or does not notice x. But then there is nothing she could do to raise the probability of *notice a picture* since in all of her doxastic alternatives there is an x such that it is the picture.

Compare with achievements that do combine with *try* (32). For Mary to *capture a mouse* requires here to perform some action Δ such that $Pr(\textbf{capture}|\Delta) > Pr(\textbf{capture}|\Delta)$. Speaking metaphorically, Mary partitions her doxastic alternatives such that she performs Δ or not and considers if doing that action makes it more likely that she will capture a mouse. Conceivably, she can do something that will make it more likely the mouse is caught—e.g. setting a trap, and therefore (32a) in this scenario is predicted to be true in this scenario.

4. Conclusion

In recent work, the incorporation of expected utility has been a fruitful way to model the lexical meaning of various items, for example, modals (Lassiter, 2017) and desiderative attitudes (Levinson, 2003). My proposal extends this expected utility framework to *try* and show how the framework can be used to capture some of *try*'s unique properties.

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Being relatively imperative in Slovenian[1]

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Abstract. Imperatives in relative clauses are crosslinguistically very rare, but occur in Slovenian with both non-restrictive and restrictive relatives. Interestingly, restrictive imperative relative clauses in Slovenian impose requirements on the contextual settings and on possible relative clause heads that other relative clauses are not subject to. We derive these restrictions by combining independently motivated assumptions about imperatives and relative clauses. Specifically, presuppositions associated with imperatives are predicted to result in infelicity unless the gap in the relative clause is associated with an entity already established in the previous discourse.

Keywords: imperatives, performative modality, presupposition projection, relative clauses, resumptive pronouns, Slovenian.

1. Introduction

Imperatives have traditionally been considered a main clause phenomenon (Sadock and Zwicky, 1985; Han, 2000).[2] However, in the past 15-20 years they have been shown to occur in embedded clauses in many languages, most prominently in speech reports.[3] (1) exemplifies this for Slovenian, where the non-quotative complementizer *da* shows that the embedded clause is an instance of indirect speech (see Sheppard and Golden, 2002; Stegovec and Kaufmann, 2015).

(1) Rekli so, **da** še kdaj povab**i** Markota.
said.PL are.3.PL **that** also when invite.**IMP** Marko.ACC
'They said you should invite Marko again.'

Imperatives in relative clauses, however, are rare crosslinguistically (van der Wurff, 2007), but Slovenian allows for these as well (Sheppard and Golden, 2002; Dvořák and Zimmermann, 2008), both in non-restrictive, cf. (2a), and in bona fide restrictive relative clauses, cf. (2b).

(2) a. Tvoja soba$_i$, **ki** jo$_i$ posesa**j**, je kot svinjak.
your.F room.F **REL** 3.F.ACC vacuum.**IMP** is like pigsty
'Your room, which you should vacuum, is like a pigsty.'
b. To je vino$_i$, **ki** ga$_i$ spi**j**, in to je vino$_j$, **ki** ga$_j$ zli**j**.
this is wine.N **REL** 3.ACC drink.**IMP** and this is wine.N **REL** 3.ACC spill.**IMP**
'This is the wine you should drink and this is the wine you should spill.'

Note that apart from its slightly more flexible embedding behavior, Slovenian imperative morphology as occurring in relative clauses is a standard imperative marker. It is, for instance, associated with the functional spectrum typical of imperative clauses across languages (see Schmerling, 1982; Kaufmann, 2012; von Fintel and Iatridou, 2017):

[1]For feedback and discussion we thank the audiences at the *Rutgers Linguistics Colloquium* (Nov 2014), the *Workshop on Relative Clauses* (Frankfurt University, May 2017), the *UConn LingLunch* (Aug 2018), *Sinn und Bedeutung 23*, as well as Adrian Brasoveanu and Rick Nouwen. The usual disclaimer applies.
[2]To be precise, *imperatives* here refers to the morphosyntactic markers characteristic of imperative clause types.
[3]Some examples: Old Germanic, Ancient Greek, Slovenian, Korean, Japanese, Mandarin, Colloquial German, English, Vietnamese, Mbyá (Tupi-Guaraní) (for discussion and references, see Kaufmann and Poschmann, 2013).

Proceedings of Sinn und Bedeutung 23, vol. 1, pp. 547–564. Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès).

(3) Spi**j** to vino.
drink.IMP.(2) this.N.ACC wine.N.ACC
'Drink this wine.'
(can be used as order, request, advice, invitation, acquiescence, ...; but not as assertion)

In the following, we will show that Slovenian imperative relative clauses retain semantic and pragmatic characteristics of matrix imperatives, which provides evidence both for their status as containing genuine imperative marking and for an analysis of imperatives that incorporates these features into their conventional meaning. Additionally, restrictive imperative relative clauses impose requirements on possible relative clause heads that other Slovenian relative clauses are not subject to.[4] We derive these restrictions from an independently motivated imperative semantics in interaction with the semantics of relative clauses. We conclude with reflections on what factors of Slovenian grammar might contribute to the availability of the crosslinguistically rare phenomenon of imperatives in relative clauses.

2. Imperative relative clauses in Slovenian

2.1. Slovenian relative clauses

Slovenian distinguishes two main types of headed relative clauses (RCs) (see Hladnik, 2015, 2016). KI-relatives are introduced by the relative complementizer *ki* and require an obligatory resumptive pronoun, cf. (4a), which is null when nominative (due to *pro-drop*) and a clitic for most other cases (Chidambaram, 2013; Hladnik, 2015, 2016).[5] In contrast, KATERI-relatives are introduced by an inflected relative pronoun and lack an overt complementizer, cf. (4b).

(4) a. KI-relative: [... RC head ... [$_{CP}$ ***ki***$_C$ ... pro$_{res}$ ...] ...]

b. KATERI-relative: [... RC head ... [$_{CP}$ ***kater-***GEN.NUM.CASE [$_{C'}$ ⟨C⟩ ...] ...]

Both types of relative clauses can yield *restrictive*, cf. (5), and *appositive* readings, cf. (6):[6]

(5) a. Slikali so samo nogo, **ki** sem si *jo* zlomil.
took.picture.PL are.3.PL only leg.F REL am REFL.DAT 3.F.ACC break.M
'They only took an X-ray of the leg that I broke [it].'

b. %Slikali so samo nogo, **kater**o sem si zlomil.
took.picture.PL are.3.PL only leg.F, which.F.ACC am REFL.DAT break.M
'They only took an X-ray of the leg that I broke.'

(6) a. Marko, **ki** *ga* moraš še kdaj povabit, je bil vsem všeč.
Marko REL 3.ACC must.2 also when invite.INF is been.M all.DAT liked
'Everyone liked Marko, who you should invite [him] again.'

b. %Marko, **katere**ga moraš še kdaj povabit, je bil vsem všeč.
Marko which.ACC must.2 also when invite.INF is been.M all.DAT liked
'Everyone liked Marko, who you should invite again.'

[4]Paul Portner (p.c.) suggests that English infinitival relatives might be subject to the same restrictions. But the two phenomena differ at least in what noun phrases the relative clauses can modify (Sect. 3.3; for for quantificational examples in English, see Bhatt, 1999; Hackl and Nissenbaum, 2012).

[5]The obligatory resumptive pronoun in KI-relatives can only be a tonic pronoun (as opposed to a clitic pronoun or null *pro*) if it serves as the object of a preposition or it must bear focus (see Hladnik, 2015: 26, 42).

[6]Note that we will translate the modal verb *mora-* with 'should' as an approximation of the modal's interpretation (although English 'must' is the Slovenian modal's etymological equivalent, so we still use it in the glosses).

KATERI-relatives are perceived as marked with subject, direct object, and indirect object relativization (hence the '%'), while with prepositional object and possessor relativization, KI-relatives are more marked (Hladnik, 2015: Ch. 4). In the following, we focus on KI-relatives, since our syntactic contexts involve direct/indirect object relativization and we want to control for independent markedness effects given the rather sensitive grammaticality judgments.

2.2. Adding imperatives

Sheppard and Golden (2002) observe that Slovenian relatives clauses can contain imperative marking (see also Dvořák and Zimmermann, 2008), which can roughly be translated into English using the modal *should*. The appositive example in (7) is a minimal modification of (6).

(7) Marko, **ki** *ga* še kdaj povab**i**, je bil vsem všeč.
Marko REL 3.ACC also when invite.IMP is been.M all.DAT liked
'Everyone liked Marko, who you should invite [him] again.'

Contrary to a hypothesized universal gap (van der Wurff, 2007), imperatives are also allowed in restrictive relatives. Stegovec and Kaufmann (2015) demonstrate their restrictive nature based on the role of relative clauses in identificational constructions, as in (8a) and (8b), as well as the possibility of attachment to non-referential heads, as in (8c).

(8) a. To je vino$_i$, **ki** *ga$_i$* spi**j**, in to je vino$_k$, **ki** *ga$_k$* zli**j**.
this is wine.F REL 3.ACC drink.IMP and this is wine.F REL 3.ACC spill.IMP
'This is the wine you should drink [it] and this the wine you should spill [it].'

b. TO je knjiga$_i$, **ki** *jo$_i$* preber**i**, in ne tista$_j$ na polici.
this is book.F REL 3.F.ACC read.IMP and not that.F on shelf.LOC
'THIS is the book that you should read [it] and not the one on the shelf.'

c. Na mizi so vsi članki$_i$, **ki** *jih$_i$* preber**i** do jutri.
on table.LOC are.3.PL all papers REL 3.PL.ACC read.IMP by tomorrow
'On the table are all the papers that you should read [them] by tomorrow.'

But not all restrictive relative clauses that can be expressed with a suitable overt modal can also be realized with an imperative. In the following, we first look at semantic and pragmatic differences between modals and imperatives at the matrix level (Sect. 3.1), turning then to restrictions on the use of well-formed sentences containing imperative relatives (Sect. 3.2). Lastly, we look at restrictions on what combinations of imperative relative clauses and nominal heads are acceptable (Sect. 3.3).

3. Restrictions on the use of (relative) imperatives

3.1. Imperatives as performative modals

The semantic vicinity of imperatives to prioritizing necessity modal verbs,[7] like English *should* (witnessed by the preferred translations of Slovenian imperative relative clauses), extends to matrix clauses as well. Kaufmann (2012) (a revised version of Schwager, 2006) proposes to interpret imperatives and (prioritizing necessity) modals alike at the at-issue level, but argues that

[7] *Prioritizing modality* is Portner's 2007 cover term for deontic, bouletic, and teleological modality.

they differ in the presuppositions they trigger. Imperatives require *Practicality*, *Answerhood*, and *Endorsement*, which confines them to performative, that is, non-descriptive uses:

(9) a. *Practicality*: Imperatives are used to address decision problems, specifically, the question of 'what should [*the addressee*] do?'

We will think of *Practicality* as the property of an utterance context that the *Question under Discussion (QUD)* (in the sense of Ginzburg, 1996 or Roberts, 1996) is of that nature.

b. *Answerhood*: Imperatives have to provide an answer to such a contextually given decision problem, that is, the state of affairs named in an imperative has to single out as optimal a course of action from a set of chooseable alternatives.[8]

c. *Endorsement*: Imperatives commit the speaker to the endorsement of that choice (that is, speakers cannot use imperatives to single out actions as optimal according to other sources that they might disagree with).

Following Kaufmann (2012), imperatives can be used felicitously only in contexts that meet these requirements,[9] which is ensured by endowing imperative markers with presuppositions to this effect. Modal verbs, in contrast, lack presuppositions along these lines.

(10)

	modal verb:	imperative:
at-issue level:	*you should P*	*you should P*
presuppositional level:		decision problem for addressee *P* answers decision problem speaker endorses *P* ...

From this, it follows that modal verbs *can* be used performatively, namely if they happen to be used in a context that meets these requirements. In contexts that do not meet them, they can still be used felicitously to describe modal states of affairs. Imperatives, however, *must* be used performatively: their use in a context that does not meet these requirements results in infelicity.

3.2. Main clause behavior of IMPRCs

Despite their occurrence in an embedded position, imperatives in relative clauses (henceforth IMPRCs) retain the semantic and pragmatic traits of main clause imperatives. Firstly, IMPRCs retain *Practicality* and *Answerhood*. In the case of matrix imperatives, this results in them being infelicitous in contexts where the action they select is known to be unavailable:

(11) [CONTEXT: The novel 'Alamut' is sold out everywhere and can't be bought.]

#Alamut je tako dobra knjiga. Kup**i** jo!
Alamut is such good.F book.F buy.**IMP** 3.F.ACC
'Alamut is such a good book. Buy it!'

[8] See Cariani et al. (2013) for critical discussion and a working definition of 'chooseable'.

[9] For simplicity, we ignore wish uses of imperatives, which become possible only when a practical interpretation is impossible; cf. Schwager (2006); Kaufmann (2016), Condoravdi and Lauer (2012).

Similarly, IMPRCs are infelicitous if the course of action expressed in the imperative is presented as impossible, cf. (12a) (vs. (12b)), or not to be taken for granted as a choice, cf. (13). With modal verbs, no such restriction arises, as seen with the contrast between (12a) and (12c).

(12) a. #Knjiga, **ki** *jo* kup**i**, je povsod razprodana.
book.F **REL** 3.F.ACC buy.**IMP** is everywhere sold.out.F
'The book that you should buy [it] is sold out everywhere.'

b. Knjiga, **ki** *jo* kup**i** takoj, ko bo na voljo, še ni izšla.
book.F **REL** 3.F.ACC buy.**IMP** at.once when will.3 on will yet NEG.3 out.F
'The book that you should buy [it] as soon as its available is not out yet.'

c. Knjiga, **ki** *jo* **moraš** kupiti, je povsod razprodana.
book.F **REL** 3.F.ACC **must.**2 buy.INF is everywhere sold.out.F
'The book that you should buy [it] is sold out everywhere.'

(13) [CONTEXT: On the way to a bookstore with you, I think of a rare book that I think you should read and I now want to buy it for you. But I've never been to this bookstore, so I have no idea if they will have it there. I then tell you:]

a. #Hočem ti kupit knjigo, **ki** *jo* prebe**ri**.
want.1 2.DAT buy.INF book.F.ACC **REL** 3.F.ACC read.**IMP**
'I want to buy you a book that you should read [it].'

b. Hočem ti kupit knjigo, **ki** *jo* **moraš** prebrati.
want.1 2.DAT buy.INF book.F.ACC **REL** 3.F.ACC **must.**2 read.INF
'I want to buy you a book that you should read [it].'

Kaufmann (2012) motivates her analysis in terms of presuppositions with data that suggest that these requirements can get *filtered* (Karttunen, 1974). Filtering carries over to IMPRCs:

(14) A: *I think the book might be sold out here, but …*

A: #… *Alamut* je knjiga, **ki** *jo* kup**i**.
… Alamut is book.F **REL** 3.F.ACC buy.**IMP**
'… 'Alamut' is the book that you should buy [it].'

A: … če jo imajo, je *Alamut* knjiga, **ki** *jo* kup**i**.
… if 3.F.ACC have.3.PL, is Alamut book.F **REL** 3.F.ACC buy.**IMP**
'… if they have it, then 'Alamut' is the book that you should buy [it].'

Secondly, speakers of imperatives have to endorse that the course of action expressed in the imperative be chosen (*Endorsement*), cf. (15a), whereas no such restrictions hold for corresponding modals, that can be anchored to sources they may not agree with, cf. (15b):

(15) a. #Prebe**ri** to knjigo. Ampak nočem, da jo prebereš.
read.**IMP** this.F.ACC book.F.ACC but not.want.1 that 3.F.ACC read.2
'Read this book. But I don't want you to read it.'

b. Moraš prebrati to knjigo. Ampak nočem, da jo prebereš.
must.2 read.INF this.F.ACC book.F.ACC but not.want.1 that 3.F.ACC read.2
'You should read this book. But I don't want you to read it.'

The contrast carries over to IMPRCs and their modal verb counterparts, cf. (16a) vs. (16b):

(16) a. #To je knjiga, **ki** *jo* prebe**ri**. Ampak nočem, da jo prebereš.
this is book.F REL 3.F.ACC read.IMP but not.want.1 that 3.F.ACC read.2
'This is the book you should read [it]. But I don't want you to read it.'

b. To je knjiga, **ki** *jo* moraš prebrati. Ampak nočem, da jo prebereš.
this is book.F REL 3.F.ACC must.2 read.INF but not.want.1 that 3.F.ACC read.2
'This is the book you should read [it]. But I don't want you to read it.'

Note that the imperative versions in (15a) and (16a) are perfectly acceptable in the absence of the distancing follow-up: 'But I don't want you to read it'.

3.3. Possible types of IMPRCs and their heads

The appearance of IMPRCs is constrained not only by discourse properties of prejacent and modality in question, but also by the type of relative clause. In general, IMPRCs can occur as appositive relatives, but they can also occur as restrictive relative clauses provided their heads are (i) definites, (ii) specific indefinites, or (iii) universal quantifiers. Unspecific indefinites, negative or proportional quantifiers (translating English *most*) are generally unacceptable but can be rescued by the use of plural resumptives. In the following, we will briefly exemplify acceptable types of restrictive IMPRCs.

Definite descriptions. Both examples in (17) require that the relative clause ensures the uniqueness of the definite description, thus it has to be used restrictively.

(17) a. To je knjiga, **ki** *jo* prebe**ri**.
this is book.F REL 3.F.ACC read.IMP
'This is the book you should read [it].'

b. *Alamut* je knjiga, **ki** *jo* prebe**ri**.
Alamut is book.F REL 3.F.ACC read.IMP
''Alamut' is the book you should read [it].'

Universal quantifiers. In principle, one might argue that relative clauses attached to universal quantifiers could receive appositive readings if they are predicated of the entire witness set for the universal quantifier. However, such an interpretation is ruled out by the context in which we present (18), where the relative clause serves to single out a subset of the papers discussed:

(18) A: *'There are some papers you'll have to read some time during the semester. I put them on the shelf . . . '*

A: Na mizi pa so vsi članki$_i$, **ki** *jih$_i$* prebe**ri** do jutri.
on table.LOC CONTRAST are.3.PL all papers REL 3.PL.ACC read.IMP by tomorrow
'. . . and on the table are all the papers you should read [them] by tomorrow.'

Specific indefinites. When anchoring to an indefinite, IMPRCs enforce a specific reading, cf. (19a); the unspecific cardinal reading exemplified in (20a) is unacceptable. In contrast, relative clauses containing modal verbs are felicitous in both contexts, cf. (19b) and (20b).

(19) [CONTEXT (SPECIFIC): You're looking for book suggestions for the summer. This is the perfect opportunity to finally make you read my favorite book:]

a. Poznam eno knjigo$_i$, **ki** *jo$_i$* preber**i**.
know.1 one.F book.F **REL** 3.F.ACC read.**IMP**
'I know one book you should read [it].'

b. Poznam eno knjigo$_i$, **ki** *jo$_i$* **moraš** prebrati.
know.1 one.F book.F **REL** 3.F.ACC **must.**2 read.INF
'I know one book you should read [it].'

(20) [CONTEXT (NON-SPECIFIC): I challenge you to read at least 10 books over the summer. Soon after, we decide to go camping for the weekend, and I see you filling up a backpack with a ton of books. Annoyed, I tell you:]

a. #S sabo lahko vzameš eno knjigo$_i$, **ki** *jo$_i$* preber**i**.
with self.ACC can take.2 one.F book.F **REL** 3.F.ACC read.**IMP**
'You can take with you one book you should read [it].'

b. S sabo lahko vzameš eno knjigo$_i$, **ki** *jo$_i$* **moraš** prebrati.
with self.ACC can take.2 one.F book.F **REL** 3.F.ACC **must.**2 read.INF
'You can take with you one book you should read [it].'

Negative quantifiers. Finally, IMPRCs are generally unacceptable when attached to negative quantifiers; compare the IMPRC in (21a) with the felicitous modal in (21b).[10]

(21) a. *Nobena knjiga$_i$, **ki** *jo$_i$* preber**i**, ni debela.
no.F book.F **REL** 3.F.ACC read.**IMP** NEG.3 thick.F
'No book that you should read [it] is thick.'

b. Nobena knjiga$_i$, **ki** *jo$_i$* **moraš** prebrati, ni debela.
no.F book.F **REL** 3.F.ACC **must.**2 read.INF NEG.3 thick.F
'No book that you should read [it] is thick.'

Negative quantifiers can, however, become acceptable with negative quantification over a given set of books realized in a partitive construction, but this requires a plural resumptive pronoun:

(22) [CONTEXT: I've put together a reading list for you for the summer. But I also know your prejudice against thick books, so I reassure you:]

a. Nobena od knjig$_i$, **ki** *jih$_i$* preber**i**, ni debela.
no.F of books.F.GEN **REL** 3.F.ACC read.**IMP** NEG.3 thick.F
'None of the books that you should read [them] is thick.'

b. Nobena od knjig$_i$, **ki** *jih$_i$* **moraš** prebrati, ni debela.
no.F of books.F.GEN **REL** 3.F.ACC **must.**2 read.INF NEG.3 thick.F
'None of the books that you should read [them] is thick.'

[10]We are indebted to Simon Charlow for raising the issue at a colloquium talk the first author gave at Rutgers University on Nov 21, 2014.

3.4. Making sense of the anchor-restrictions

A first idea to block anchoring of IMPRCs to non-referential heads might be that imperatives block binding relations, and that therefore the gap in the relative clause cannot covary with a quantifier it modifies.[11] However, there are good reasons to assume that quantifier binding into imperative clauses should not be blocked categorically. Following insights by Crnič and Trinh (2009a, b), binding is standardly used to prove the non-quotational status of imperatives in speech reports, cf. (23). Example (24) shows that binding into speech reports is fine in Slovenian, too. Consequently, binding into imperative clauses seems to be available in principle.

(23) [Every professor]$_1$ said buy his$_1$ book. (Crnič and Trinh, 2009b; their (7a))

(24) Noben profesor$_i$ ni rekel, **da** kup**i** njegovo$_i$ knjigo.
no.M professor.M NEG.3 say.M **that** buy.IMP his.F.ACC book.F.ACC
'No professor$_i$ said buy his$_i$ book.'

Interestingly, in all the acceptable cases, IMPRCs occur with anchors that can establish (or pick up) discourse referents that would be suitable for free occurrences of the pronoun that appears as the resumptive, compare (25) (from Nouwen, 2014):

(25) a. Jake lives in Utrecht. **He** is a famous boxer.
b. Every boxer took part in the event. #**He** is famous.
c. Every climber made it to the summit. **They** were all experienced adventurers.

Nouwen (2014) observes that these are paralleled by nominal appositives:

(26) a. Jake, a famous boxer, lives in Utrecht.
b. Every Dutch boxer, # a famous one, took part in the event.
c. Every climber, all experienced adventurers, made it to the summit.

We conclude that IMPRCs involve a related kind of coreference between anchor and resumptive pronoun, which in this particular case pans out as a form of endocentric coreference.

(27) IMPRC-*Conjecture:* Imperatives can appear in relatives where the resumptive pronoun can co-refer with a referring expression established by the anchor (possibly together with the relative clause in which the resumptive appears).

Note that that the IMPRC-Conjecture is met trivially for appositives, where the anchor always refers independently of the relative clause.

4. Analysis

The IMPRC-Conjecture reflects our observation that in all cases of felicitious IMPRCs, there has to be a specific individual (or set of individuals) to be affected as indicated by the imperative. We take this to reflect a particular challenge that results from placing an imperative into a relative clause: (i) imperatives contain an operator OP_{Imp} that encodes the modal semantics; (ii) OP_{Imp} triggers presuppositions about its prejacent, specifically, that it needs to answer the

[11] Note that an analysis along these lines would have to make sure that relative clause formation itself is interpreted in a way that does not involve an illegitimate binding relation into the relative clause, so as not to rule out IMPRCs in general. Ultimately, we will turn things upside down, variable abstraction as associated with relative clause formation will turn out to be problematic absent special strategies, but quantifier binding into relative clauses can be unproblematic.

QUD; (iii) by standard assumptions, relative clauses contain gaps corresponding to variables bound by predicate abstraction at the top level of the relative clause. The LF of an IMPRC is assumed to look roughly like (28):

(28) the book [that$_x$ OP_{Imp} [you read t_x]]

As outlined above, OP_{Imp} contains a variable that is bound only above OP_{Imp} (the variable is thus free in the sister of OP_{Imp}). It is thus predicted that OP_{Imp} presupposes that 'you read *x*' answers the QUD—unlike free variables used to represent referential pronouns, this *x* is bound higher in the structure and can thus not be assumed to receive a stable interpretation in the given discourse context. Technically, the interpretation of the string in the discourse content is defined at best accidentally and cannot be expected to represent an answer to the QUD.[12]

In contrast, modal verbs do not trigger such presuppositions regarding their prejacent, which means that an LF like (29) is not predicted to be infelicitous.

(29) the book [that$_x$ [must/should/… [you read t_x]]]

If this account is on the right track, we might expect a univeral ban on IMPRCS, which is, however, falsified by the Slovenian data discussed above. We would like to argue that Slovenian can circumvent the issue resulting for a structure like (28) thanks to a resumptive pronoun: with suitable relative heads, the resumptive pronoun can do double duty as a bound variable and as a free pronoun. The crucial structure is exemplified in (30):[13]

(30) the book [that$_x$ [OP_{Imp} [you read t_x^{it}]]]

The idea is that the relative clause should feed into the at-issue interpretation the property of being a book that you will read (λx.*you should read x*), it will generate a presupposition involving the proposition expressed by *you read it*, and the resumptive relative clause head ensures that *x* and *it* are identified. The intended prediction is that IMPRCs are well-formed as long as the resumptive pronoun *it* can be interpreted as referring to an independently given entity. In the following, we propose an implementation of this general idea in presuppositional DRT (van der Sandt, 1992),[14] without intending to argue that other systems might not lend themselves to equally successful and potentially more elegant solutions (consider for instance Bumford, 2017).

[12]In this we are glossing over an intricacy with the types of examples we are considering: if the imperative morphology indicates that the QUD is of the form 'what should *addressee* do?', then the entire utterance fails to provide a direct answer to it. Speech reports are often argued to allow for cases where the embedded rather than the entire sentence relates to the QUD (Anand and Hacquard, 2014; Antomo, 2015).

[13]This exceptional property of the resumptive pronoun could be related to another case where Slovenian clitic pronouns are semantically exceptional, that is: unlike regular pronouns, they permit both *strict* and *sloppy identity readings* (see Runić, 2014; Bošković, to appear). This exceptional behavior has been attributed to either a more complex semantic type of the pronouns (Tomioka, 2003; Runić, 2014) or the presence of an unpronounced doubled NP (Bošković, to appear; cf. Elbourne, 2005). Both approaches could in principle be related to the double duty of Slovenian resumptive pronouns, but we leave further development of this idea for future research.

[14]Sells (1984) develops a similar account of Strong Crossover Effects in relatives.

4.1. Implementation

We assume that Slovenian is translated into a language of presuppositional DRT as developed by van der Sandt (1992), which is interpreted in a possible worlds model that, in addition to a set of ordinary individuals D_e, contains also a set of events D_ε, and of worlds W (all non-empty and mutually disjoint). Moreover, there is a special set of speech events D_ε^{speech} (a subset of D_ε). In addition to discourse markers for simple individuals (type e), we add discourse markers for events (type ε). An utterance context c is understood as a (speech) event c_E that determines a speaker c_S, an addresssee c_A, their common ground $CG_c \subseteq W$ and a question under discussion $QUD_c \subseteq \mathscr{P}(W)$. To encode the presuppositions of the imperative operator, we introduce the constants SPEECHEVENT, PRACTICAL, and ANSWER into the DRS-language:

(31) a. $[\![\text{SPEECHEVENT}]\!]^c(e) = 1$ iff $e \in D_\varepsilon^{speech}$.
b. $[\![\text{PRACTICAL}]\!]^c(c') = 1$ iff the $QUD_{c'}$ is of the form 'what will you do',
that is, $QUD_{c'} =$
$\{p \subseteq W \mid \exists\delta[\delta$ characterizes a choosable action for c'_A in c' and $p = \lambda w.\delta(c'_A)]\}$.
c. $[\![\text{ANSWER}]\!]^c(p, c') = 1$ iff p is at least a partial answer to the QUD of c',
that is, $\mid \{q \mid q \neq \emptyset \wedge \exists q'[q' \in QUD_{c'} \wedge q = (p \cap q')]\} \mid < |QUD_{c'}|$.

For the string 'the book that read (it)', we assume the LF in (32). To capture the (potential) double nature of the resumptive pronoun *it* as simultaneously bound and free, we translate the relative clause in (32) according to (33).

(32) the book [that$_{i,j}$ [OP_{Imp} [you read [it$_j$ *book*]]]]

(33) $that_{i,j}\ \phi \rightsquigarrow \lambda x. \begin{array}{|l|}\hline \\ \hline x = y \\ \phi' \\ \hline \end{array}$, if $\phi \rightsquigarrow \phi'$.

The gap '*it$_j$ book*' in (32) is interpreted like an anaphoric definite, which means that y needs to be identified with an *accessible* discourse referent (van der Sandt, 1992; we assume that accommodation fails for reasons having to do with *Answerhood*).[15] The imperative operator OP_{Imp} is translated as a particular necessity operator NEC, as shown in (35).

(34) $it_j\ book \rightsquigarrow \partial \left(\begin{array}{|l|}\hline y \\ \hline book(y) \\ \hline \end{array} \right)$

(35) $OP_{Imp} \rightsquigarrow \lambda p.\text{NEC} \begin{array}{|l|}\hline \\ \hline \text{p} \\ \partial \left(\begin{array}{|l|}\hline e \\ \hline \text{SPEECHEVENT}(e) \\ \text{PRACTICAL}(e) \\ \text{ANSWER}(p, e) \\ \hline \end{array} \right) \\ \hline \end{array}$

Crucially, NEC (i) has the at-issue meaning of a Kratzerian necessity modal (*have to, should*),

[15] As a merely notational deviation from van der Sandt's dotted boxes, we employ the partial operator ∂ to indicate that a DRS is presupposed.

and (ii) triggers presuppositions ensuring performativity (Kaufmann, 2012, 2016). Specifically, *Practicality* and *Answerhood* are modeled as requirements on a salient speech event, represented as e. In the absence of a speech report, e will get anchored to the referent for the actual utterance event. With this, the restricted occurrence of IMPRCs can now be derived from the need to resolve the specific presuppositions. Following standard assumptions (van der Sandt, 1992), starting from the innermost presuppositional DRS, presupposed discourse referents have to be resolved by (i) binding to accessible discourse referents, where conditions on them are dragged along to the DRS where they are resolved, or (ii) accommodated in accessible sites; van der Sandt (1992) argues that binding is preferred. Under the assumptions outlined above, we assume that (36) will be translated and interpreted as described in the following.

(36) This is the book [that$_{i,j}$ [OP_{Imp} [you read [it$_j$ *book*]]]].

First of all, we observe that the sentence can be uttered felicitously only if a referent for a unique particular book that is to be read is already given (here, b). Taking for granted referents for speaker, hearer, and utterance events (see Hunter, 2013 for details on indexicals), we therefore assume that the pre-context is represented as K_0:

(37) K$_0$: $\begin{array}{|l|}\hline c_S, c_A, c_E, b \\ \hline b = \max_x(\text{book-}c_A\text{-should-read}(x)) \\ \hline \end{array}$

The entire relativized noun phrase from (32) (which is a definite description and therefore presupposed) then amounts to the condition shown in (38).

(38) the book that$_{i,j}$ OP_{Imp}you read [it$_j$ *book*] $\rightsquigarrow \partial \left(\begin{array}{|l|}\hline y \\ \hline \text{book}(y) \\ y = z \\ \text{NEC} \begin{array}{|l|}\hline \\ \hline \text{read}(c_A, z) \\ \partial \left(\begin{array}{|l|}\hline e \\ \hline \text{SPEECHEVENT}(e) \\ \text{PRACTICAL}(e) \\ \text{ANSWER}(\text{read}(c_A, z), e) \\ \partial \left(\begin{array}{|l|}\hline z \\ \hline \text{book}(z) \\ \hline \end{array} \right) \\ \hline \end{array} \right) \\ \hline \end{array} \\ \hline \end{array} \right)$

When the deictic subject *this* is introduced, the statement that it is identical to the complex definite in (38) ($T = y$) updates K_0 to (39).

(39)

c_S, c_A, c_E, b, T

$b = max_x(\text{book-}c_A\text{-should-read}(x))$
$\text{this}(T)$
$T = y$
$\partial\left(\begin{array}{|l|}\hline y \\ \hline \text{book}(y) \\ y = z \\ \text{NEC}\ \begin{array}{|l|}\hline \\ \hline \text{read}(c_A, z) \\ \partial\left(\begin{array}{|l|}\hline e \\ \hline \textsc{SpeechEvent}(e) \\ \textsc{Practical}(e) \\ \textsc{Answer}(\text{read}(c_A, z), e) \\ \partial\left(\begin{array}{|l|}\hline z \\ \hline \text{book}(z) \\ \hline \end{array}\right) \\ \hline \end{array}\right) \\ \hline \end{array} \\ \hline \end{array}\right)$

The presupposed discourse referents can now be resolved starting with the innermost (the boldfaced resolutions in (40) have happened in order of appearance) and consequently drag along their conditions into the main box:

(40)

c_S, c_A, c_E, b, T

$b = max_x(\text{book-to-read}(x))$
$\text{this}(T)$
$T = y$
$\mathbf{z = b}$
$\text{book}(z)$
$\mathbf{e = c_E}$
$\textsc{SpeechEvent}(e)$
$\textsc{Answer}(\text{read}(c_A, z), e)$
$\mathbf{y = b}$
$\text{book}(y)$
$y = z$
$\text{NEC}\ \begin{array}{|l|}\hline \\ \hline \text{read}(c_A, z) \\ \hline \end{array}$

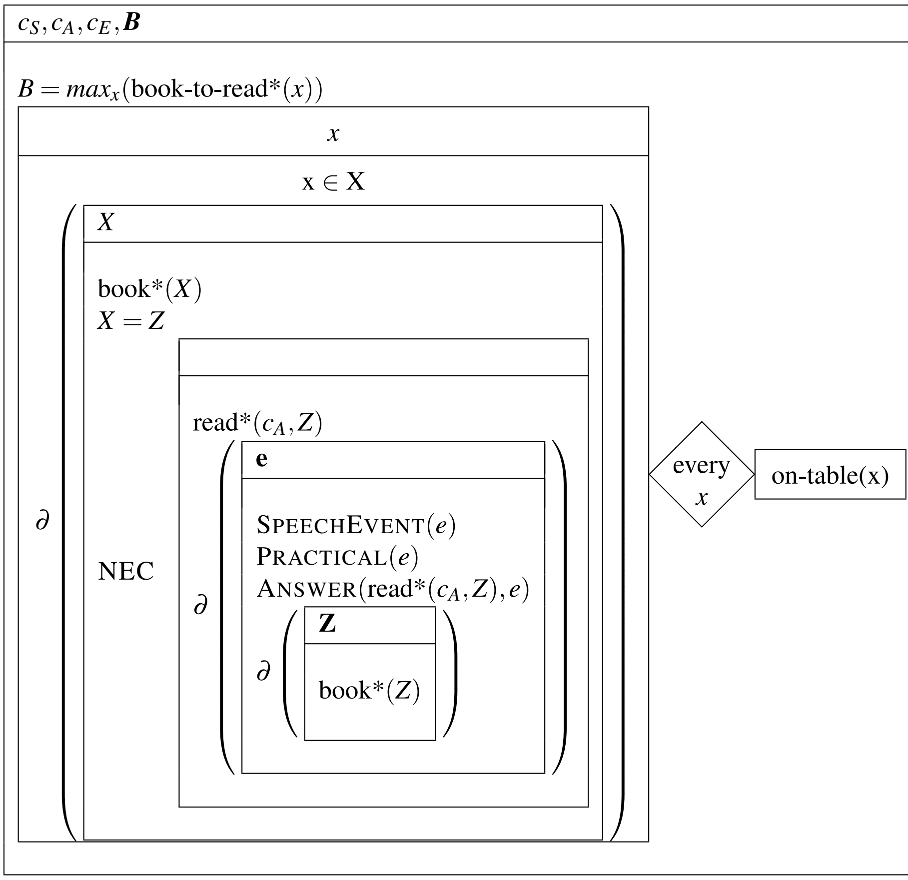
As b is identified with the contextually given referent for 'the book to read' ($\mathbf{z = b}$), an instruction for c_A to read z is sensible. The only available antecedent for e is the actual utterance event c_E. If e is bound to c_E, then $\textsc{Answer}(\text{read}(c_A, z), e)$ is placed into the main DRS. This condition contains the presupposed discourse referent z corresponding to the resumptive pronoun.

z has, however, already been identified with the discourse referent for a particular book represented by b. By this, ‘read(c_A, z)’ represents a proposition that naturally meets the *Answerhood* requirement with respect to the utterance event c_E (with which e has been identified). The proposed resolution is also plausible in terms of the presuppositions the imperative imposes with respect to its prejacent.

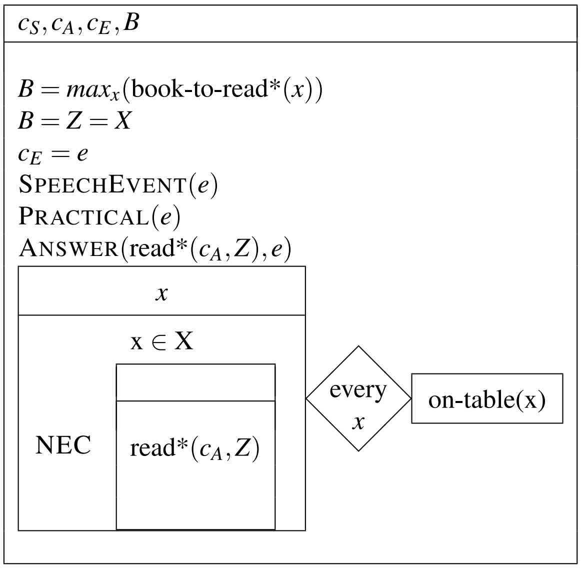
Recall that IMPRCs can also modify strong quantifiers (‘all books’, ‘each of the books’, ‘none of the books’, …; see (18), (22a)). However, in these cases, the relative clause has to contain a plural resumptive. Such examples are felicitous only if there is a salient set of books to read—in analogy to the singular case, we model this by the presence of a discourse referent B in the input context K_0 for a plural individual of books that are to be read (for simplicitly conceived of as a set of individuals; where * marks predicates applying to pluralities in at least one argument position). Quantification proceeds over the atoms of the plural individual.

(41) Each of the books [that$_{i,j}$ [OP_{Imp} [read [them$_j$ *books*]]]] is on the table.

(42)

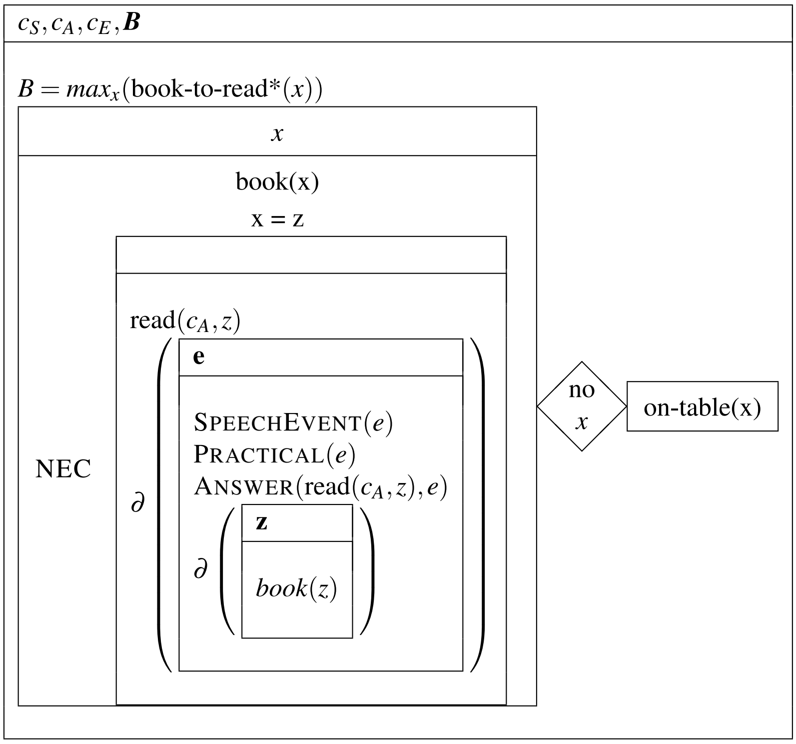


Here, the presupposed plural discourse referent that also appears in the proposition subject to the *Answerhood*-condition can be resolved to the contextually given discourse referent for a book plurality, and the resolution proceeds analogously to the definite in (40); as seen in (43).

(43) 

In contrast, quantifiers binding singular pronouns are predicted to give rise to unresolvable presuppositions, which explains the unacceptability of (44): if z were resolved to the bound variable x, the only candidate to resolve e to (namely, c_E) would lead to copying ANSWER(read(c_A, z)) into the main DRS, where z remains free.

(44) *No book [that$_{i,j}$ [OP_{Imp} [you read [it$_j$ *book*]]]] is on the table.

(45) 

Things are, however, slightly more complicated. This becomes obvious from (46a), which involves universal quantification with a co-varying singular resumptive pronoun.

(46) [CONTEXT 1 (SPECIFIC): I've put together a reading list for you for the summer. But I also know you only ever read really thick books, so I reassure you:]

a. Vsaka knjiga$_i$, **ki** *jo$_i$* prebe**ri**, je debela.
each.F book.F REL 3.F.ACC read.IMP is thick.F
'Each book that you should read [it] is thick.'

b. Vsaka knjiga$_i$, **ki** *jo$_i$* **moraš** prebrati, je debela.
each.F book.F REL 3.F.ACC **must.**2 read.INF is thick.F
'Each book that you should read [it] is thick.'

We argue that this is a case of 'endocentric' telescoping: as in (47) (from Keshet, 2007; his (2) with the crucial dependency highlighted), the free pronoun introduced by the referent is bound in a landing site which should be inaccessible to the quantifier.

(47) **Each** degree candidate accepted his diploma and **his** mother took a picture.

As with classical telescoping, the constellation is available for *each* but not for *no*. Classical telescoping is subject to specific discourse conditions, specifically, that the quantification over individuals corresponds to a quantification over cases involving these single individuals. While a full-fledged account for (46a) has to be left to future research, we assume that, in the endocentric cases, the connection between at-issue content and presupposed content somehow assimilates the required constellation.[16]

4.2. A note on binding into speech reports

In the previous section, we have argued that binding into imperatives, as resulting in relative clauses, is felicitous only if the gap can at the same time be interpreted as referential. This ensures that the prejacent of the imperative operator expresses a proposition that can, in the given utterance context, constitute an answer to the QUD (as required by the imperative operator). This, however, raises the question why quantifier binding into imperative clauses is acceptable:

(48) λc [every professor [1 [said$_c$ $\lambda c'$ $OP_{Imp c'}$ [read his$_1$ book]]]]

We assume that in these cases *Practicality* and *Answerhood* are evaluated in the scope of the quantifier, so the gap in the relative clause ends up being co-bound with a contextual parameter relevant for determining *Answerhood*.

Following Pak et al. (2008) and Stegovec and Kaufmann (2015) we assume that speech reports with embedded imperatives involve indexical shift. Independent evidence for this comes from the distancing facts, where what is required of the utterance speaker in a main clause imperative (namely, endorsement of the modality in question), comes to be required of the referent of the matrix subject.

(49) a. #Rekel je$_i$, **da** pojd**i** stran in dodal da noče$_i$, da greš.
said.M is **that** go.IMP away and added that not.want.3 that go.2
'He said you should go away and added he doesn't want you to.'

[16] We might assume, for instance, that the universal quantifier outscopes an existentially quantified variable over events of practical deliberation, with respect to which a local 'QUD' can be accommodated, similarlty to what is discussed in Section 4.2.

b. Rekel je, **da** pojd**i** stran ampak noče-m, da greš.
said.M is **that** go.IMP away but not.want-1 that go.2
'He said you should go away, but I don't want you to go.'

Thus, *said* occurs in the scope of the universal quantifier and introduces existential quantification over speech events c' (the locally introduced 'reported' contexts): 'for every professor x, there is a speech event c', s.t.... '. But this means that the discourse referent for a speech event e that is presupposed by the imperative gets resolved within the scope of the universal quantifier by binding to the existentially quantified c'. Consequently, all occurrences of the variable translating the pronoun his_1 remain in the scope of the universal quantifier and hence bound.

In IMPRCs, however, the speech event relevant for resolving *Answerhood* is the utterance event, which forces conditions containing the pronoun to appear outside of the scope of its binder (the relative clause operator giving rise to predicate formation). The distancing data provide independent evidence that, in this case, the utterance event (and its speaker) are the parameters relevant for the interpretation of the imperative, so IMPRCs are predicted to behave like matrix imperatives in this respect.

5. Conclusions

In this paper, we have addressed a counterexample to what appeared to be a universal constraint against imperative marking in relative clauses by investigating the case of Slovenian, which uses imperatives relatively flexibly in appositive and restrictive relative clauses. We have emphasized that Slovenian relative clause imperatives have to meet standard contextual requirements for imperatives (modeled as presuppositions), which in the general case results in presuppositions involving unbound variables. We have argued that Slovenian can circumvent this problem by employing resumptive pronouns. In addition to allowing us to capture differences between certain kinds of acceptable constellations, we think that this provides a first clue as to why Slovenian is special in allowing for imperatives in restrictive relative clauses to begin with. If our account is on the right track, we would expect that, absent different strategies for relative clause formation, imperative relative clauses are acceptable only in languages that have relative clauses that employ resumptive pronouns. Moreover, Slovenian is also special in allowing for imperatives to occur in indirect speech reports that are introduced with the overt declarative complementizer *da* ('that'). We would like to suggest that this indicates that a position in the left periphery of imperative clauses is kept available in Slovenian but engaged differently in many other languages. In Slovenian imperatives, it can be used for the realization of a complementizer in speech reports, or also for a relative clause abstractor in imperative relative clauses. Future work will have to establish what other factors might contribute to the exceptional status of Slovenian imperative relative clauses and if, as we would expect, other languages that combine these two properties would also allow for the occurrence of imperative relative clauses. Finally, it would be interesting to compare this phenomenon to other so called root phenomena in relative clauses (Jacobs, 2018). Interestingly, the restrictions on what are possible head nouns for Slovenian imperative relative clauses do not match up with the occurrence of German discourse particles or also imperatives in German V2 relatives (Stegovec and Kaufmann, 2015) (the latter, for instance, anchor readily to discourse new indefinites, which is at odds with the restrictions observed for Slovenian imperative relative clauses). Yet another case worth comparing appear to be imperatives in relative clauses in Ancient Greek, for which Medeiros (2013, 2015) does not report specific restrictions.

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Discourse plurals in an update semantics[1]

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Abstract. Quantification famously licenses later reference to the set of individuals quantified over, as in "Almost every student wrote an extra-credit paper. They wanted to improve their grades." Reference is also possible to other sets of individuals introduced in the quantification, as in "Almost every student wrote an extra-credit paper. They are sitting in a pile on my desk." Previous work has cast doubt on whether such reference is available within the quantification itself, but this paper argues that it is available internally, as in "Most North Atlantic countries signed a treaty declaring that an attack on one of them an attack on all of them," where the pronouns 'them' refer only to the signatory countries. Once such internal reference is allowed, it turns out that several other difficult phenomena can be captured without further machinery, such as reciprocals, cumulative readings, and sentences with 'same' and 'different.'

Keywords: dynamic semantics, plural logic, update semantics, discourse plurals

1. Introduction

This might seem like a paper about plural pronouns – and it is! – but it's part of a larger project to explore just how simple our theory of semantics can be. Can we get away with fewer rules of interpretation? Can we represent meanings via simpler data structures, e.g. sets instead of sets of sets? I take these questions to be inherently interesting, but if you disagree, just concentrate on the narrow analysis of plurals and translate the framework into your favorite system.

The main empirical claims of this paper pertain to so-called ***discourse plurals***:

(1) a. Most students in my class wrote a final paper.
    b. The rest of them completed a different final project. [Restrictor Set]

(2) a. Most students in my class wrote a final paper.
    b. They left them in a pile on my desk. [Nuclear Scope Set] [Dependent Set]

Quantified sentences like (1a) and (2a) license subsequent plural pronouns referring to various sets related to the quantification. The pronoun *them* in (1b) refers to the ***restrictor set***, the set of individuals defined only by the quantifier's restriction, *students in my class* in this case. The pronoun *they* in (2b) refers to the ***nuclear scope set***, the subset of the restrictor set that satisfies the nuclear scope, e.g., just those students who wrote a final paper in (2). (I indicate this by highlighting the whole DP.) Finally, pronouns may also target individuals introduced within the quantification, such as the papers in (2), as illustrated by *them* in (2b). I will call such sets ***dependent sets***.

The discourse plural pronouns presented above all occur outside the quantified sentence that licenses them, and I will therefore call these ***external*** discourse plurals. The empirical question I will pursue below is whether there are ***internal*** discourse plurals, accessible within the very sentences that define them. Kamp and Reyle (1993) and Nouwen (2003, 2007) argue that internal reference to discourse plurals is impossible, based on the following example sentence:

[1]Thanks to Jakub Dotlačil and Jeremy Kuhn for extra helpful discussion!

Proceedings of Sinn und Bedeutung 23, vol. 1, pp. 565–579. Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès).

(3) a. Most lawyers hired a secretary they (jointly) interviewed.

b. $\neq$ A majority of (the) lawyers hired a secretary they jointly interviewed.

(3b) has a salient reading where *they* refers to just that majority of lawyers L who (each) hired a secretary whom L all interviewed together. This is presumably due to the indefinite nature of the subject *A majority of lawyers*, which introduces a plural discourse referent, which I called L above, which is restricted by the nuclear scope and available for pronoun reference, even within the nuclear scope.

When the indefinite *a majority of lawyers* is replaced by a quantifier, as in (3a), though, this reading disappears. In other words, the pronoun *they* in (3a) cannot refer to the nuclear scope set, but rather must refer to some other group that interviewed the secretaries hired by the lawyers in the nuclear scope set. This is due to the subject being a true quantifier rather than an indefinite. The two sentences therefore have logical forms something like (4):

(4) a. For most lawyers l [l hired a secretary that X jointly interviewed.]
(where X is previously defined)

b. There's a majority of the lawyers L and
$\forall l \in L$[l hired a secretary that L jointly interviewed.]]

Despite this evidence, I will argue that internal readings of discourse plurals do in fact exist. As a preview, consider the following:

(5) a. Most of the lawyers in the firm just hired a secretary for a new labor pool they are forming (together).

b. $\exists L$[L comprises a majority of the lawyers in the firm and
$\forall l \in L$[l hired a secretary for the pool L are forming together.]]

(5a) does have a reading, sketched in (5b), where the pronoun *they* refers to the nuclear scope set. I use cases like this to motivate machinery within a dynamic logic that easily captures such internal discourse plurals. As it turns out, such machinery can provide simpler representations of some other constructions of interest to semanticists, such as reciprocals, dependent indefinites, sentences involving *same* and *different*, and cumulative readings of modified numerals.

2. Empirical Data

But first, let's survey the empirical landscape.

2.1. Excursus: Bare Plurals

Sentences where a bare plural follows *most* (like Kamp & Reyle's counterexample in (3a)) are most easily understood as generic and in fact are resistant to episodic readings (Cooper, 1996; Matthewson, 2001; Crnič, 2009). Simply adding *of the* to such examples (to form a ***partitive***) greatly improves the episodic readings:

(6) a. Most linguists ✓are millionaires / #went to New Zealand last year.
(Matthewson, 2001)

b. Most of the linguists ✓are millionaires / ✓went to New Zealand last year.

Such sentences also resist collective and cumulative readings (Nakanishi and Romero, 2004):

(7) a. Most #(of the) boys lifted the piano (together) (Crniĉ, 2009)
b. Most #(of the) boys ate three pizzas (between them).

The collective reading in (7a), where the boys in question worked together to perform a single action, is degraded when the subject is simply *most boys* but improves when the subject is *most of the boys*. Similar results hold for the cumulative reading in (7b), where you count up the total number of pizzas eaten by the group represented by the subject of the sentence.

Crniĉ (2009) points out, though, that the episodic, collective, and cumulative readings reappear when the bare plural following *most* cannot be easily construed as a kind:

(8) a. Most linguists I ran into yesterday went to New Zealand last year.
b. Most boys taking a break right now just lifted a piano together.
c. Most boys at my party last night ate three pizzas (between them).

I will therefore be careful below to either use partitives or non-kind-denoting restrictors for quantifiers like *most*.

2.2. Collective and Cumulative Readings

Once the problem of bare plurals is addressed, and some context is added, internal readings to nuclear scope sets improve quite substantially. We will concentrate first on collective and cumulative readings:

(9) Collective Readings
a. Most (of the) lawyers in my firm gathered at the dock reserved for the private cruise they had jointly paid over $1M for.
b. Almost every woman I know rented a coach they rode in together.

(10) Cumulative Readings
a. Most (of the) boys in my study group ate three pizzas (between them) that they had brought for themselves.
b. Almost every kid I know could name at most five Senators between them even if they compared notes.

Predicates like *gather* require and those like *rent a coach (together)* prefer collective readings – the subjects of (9) performed the action in question together as a group. In (9a) the lawyers gathered as a group for a single million-dollar cruise. In (9b), the women all rented one coach and rode in it together. In both cases, the pronoun *they* / *they* refers to this whole group. Similarly, the subjects in (10) perform actions that combine to yield some total result – eating three pizzas or naming five Senators. The whole group again can easily be referred to via the pronouns *them* / *they* / *themselves* in (10a) and *them* / *they* in (10b).

Hey, wait a minute!, you might be thinking. Couldn't these collective and cumulative readings be evidence that the subjects of the sentences are acting more like indefinites? In other words, couldn't *most of the lawyers in my firm* mean something more like *a majority of lawyers in my firm* and couldn't *almost every kid I know* mean *a group comprising almost every kid I* *know*? Well, maybe. But as I show in the next section, even truly quantificational readings have plausible internal readings of nuclear scope sets.

2.3. Distributive Readings

I will take distributive readings to be a sign of true quantification, at least enough that it should rule out internal readings, if Kamp and Reyle (1993) are correct. And yet, consider the following sentence, which illustrates internal reference to the nuclear scope set within a distributive reading:

(11) Most of the employees in my division received $1,000 (apiece) in bonus pay this year for their group effort to retain our largest client.

Here the overall predicate of the VP is clearly distributive: each employee in the group received their own thousand-dollar bonus, as indicated by the acceptability of *apiece*. And yet, the pronoun *their* refers to the group as a whole. A single person may not have a "group effort," as shown in (12), so the pronoun must not be singular *they* but rather refer to the plurality in question.

(12) #I received a bonus for my group effort to retain a top client.

Further examples are shown below, with evidence of distributivity highlighted in each case:

(13) a. Most North Atlantic countries authorized a high-ranking national diplomat to sign the new treaty declaring that an attack on one of them is considered an attack on all of them. [✓ *they* = only the signatory countries]

b. Almost every woman in town drove herself alone to a field where they all gathered to discuss a secret plot. [✓ *they* = only the drivers]

c. Most lawyers in the firm just hired a personal secretary for a new labor pool they are forming (together). [✓ *they* = only the contributing lawyers]

d. Almost every friend of mine is one part-owner of a house they all share. [✓ *they* = only the cohabitating friends]

e. More than half my teammates were fined $50 (apiece) after one of them tattled on their late-night shenanigans. [✓ *them* / *their* = only the rule-breaking teammates]

In each case, despite the clear distributivity, the nuclear scope set is available for pronoun reference within the nuclear scope itself. Furthermore, sometimes the nuclear scope set pronoun itself is embedded inside the clearly distributive portion of the verb phrase, ruling out an analysis where a separate distributive operator scopes lower than the entire VP. For instance, in (13a), *them* / *they* are within an argument of the distributive VP *authorized a high-ranking national diplomat to sign …*. And in (13d), *they* clearly falls within the distributive noun phrase *part-owner of a house they all share*. This evidence calls into question the generalization posited by Kamp and Reyle (1993) and Nouwen (2003, 2007).

2.4. Internal Reference to other Discourse Plurals

Restrictor sets and dependent sets may also be the targets of pronouns inside the nuclear scope of the quantifiers that create them. Examples are shown below, again with evidence of distributivity highlighted:

(14) a. Most of the partners invested at most \$50,000 in the firm they all started together.
[✓ *they* = all the partners, restrictor set]

b. Most farmers who own a donkey had gathered them in the public field to graze.
[✓ *them* = the gathered donkeys, nuclear-scope dependent set]

(14a) shows restrictor set anaphora inside the nuclear scope. (14b) shows anaphora inside the nuclear to a dependent set whose antecedent *a donkey* is in the restrictor. In this case, the anaphora is dependent on the nuclear scope set – only donkeys that gathered are included in the pronoun *them*. [2]

3. An Update Semantics

Following Kamp and Reyle (1993), existing plural semantic systems do not allow internal reference to discourse plurals. In this section, I will describe a plural dynamic logic that can capture the new empirical data described in the previous section. I will call this logic ***PLUS*** for ***PLural Update Semantics***.

As mentioned above, though, an auxiliary goal of this paper is to test how simple our semantic system can be. To that end, we will describe a dynamic update logic whose states are single assignments, leveraging the fact that update semantics operate over sets of states in order to derive a plural semantics. The dominant existing plural logics, e.g. those following van den Berg (1996), are relational systems, rather than update systems. Relational systems give denotations to formulas that are relations over states, rather than functions over sets of states. For a simple singular logic like Dynamic Predicate Logic (Groenendijk and Stokhof, 1991: henceforth ***DPL***), this means that the denotations of formulas are relations over assignments and for van den Berg's plural logic, the denotations are relations over sets of assignments. Converting each of these logics straightforwardly to update systems would instead involve sets of assignments for DPL and sets of sets of assignments for the plural logic of van den Berg (1996). Therefore, an update semantics whose states are single assignments (and thus whose denotations are sets of assignments) is roughly at the level of the singular logic DPL in terms of state complexity.

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[2] Some types of discourse plural do not seem possible:

(i) a. #Most teachers of $\boxed{\text{(all) their}}$ kids ...

b. Most people who teach all their children ...

(ia) is an attempt at referencing the restrictor set within the restrictor itself, which runs into an apparent i-within-i violation. Although (ib) sounds much better, it's likely that *their* is bound by the relative pronoun or operator rather than established via a discourse plural. In fact, it's quite hard to even test this type of discourse plural due to these issues.

3.1. Preliminaries

PLUS is based on first-order predicate logic, and as such involves formulas with predicates and variables (semi-colons represent conjunction):

(15) `farmer(f); donkey(d)`

The interpretation of the variables in a formula requires an ***assignment***, a function mapping variables to individuals, like $g = [f \rightarrow$ `farmer_sue`$, d \rightarrow$ `daisy`$]$. For instance, if (15) is interpreted relative to g, the result has the same denotation as `farmer(farmer_sue); donkey(daisy)`.

Dynamic logics track information about possible values for variables in a formula and hence information about about the model/world. In PLUS, this information is tracked via a set of assignments, each representing a possible combination of values for variables that satisfies the formula so far. I will call single assignments ***states*** of PLUS and these sets of assignments ***information states***. An idealized discourse begins with a special information state: the singleton set containing the empty assignment (the assignment which maps no variables to any values, i.e., the empty set), represented by the "▶" symbol:

(16) $$\blacktriangleright = \{[\,]\} = \{\varnothing\}$$

This starting information state combines with formulas via the update function $+$. For instance, an expression `[x]` in PLUS essentially declares the variable x, making it available for later use in the formula. Immediately after its declaration, x may have any value in the domain $\mathcal{D}$:

(17) $$\begin{aligned} \mathit{start} + \texttt{[f]} &= \left\{ \left[\texttt{f} \rightarrow a\right] : a \in \mathcal{D} \right\} \\ &= \left\{ \begin{array}{l} \left[\texttt{f} \rightarrow \texttt{farmer\_sue}\right], \left[\texttt{f} \rightarrow \texttt{farmer\_bob}\right], \ldots \\ \left[\texttt{f} \rightarrow \texttt{daisy}\right], \left[\texttt{f} \rightarrow \texttt{bessie}\right], \ldots \end{array} \right\} \end{aligned}$$

The information state in (17) contains all assignments whose domains are just $\{$`f`$\}$ and which map `f` to a value in $\mathcal{D}$. Subsequent predicate literals, such as `farmer(f)`, narrow down the values for `f` by eliminating assignments from this set:

(18) $$\blacktriangleright + \texttt{[f]; farmer(f)} = \left\{ \left[\texttt{f} \rightarrow \texttt{farmer\_sue}\right], \left[\texttt{f} \rightarrow \texttt{farmer\_bob}\right], \ldots \right\}$$

Notice that this set now reflects something about the world/model: we can recover the set of farmers by extracting all possible values for `f` in the component assignments of the set.

3.2. PLUS v1.0

Here is our first working definition of PLUS, meant to replicate DPL (Groenendijk and Stokhof, 1991):

(19) <u>Domains</u>

$\mathcal{D}$	individuals $a, b, c, \ldots$
$\mathcal{V}$	variables $x, y, z, \ldots$
$\mathcal{G} = \mathcal{V} \nrightarrow \mathcal{D}$	partial assignments $g, h, k, \ldots$ (partial functions from $\mathcal{V}$ to $\mathcal{D}$)
$\mathfrak{G} = \wp(\mathcal{G})$	information states $G, H, K, \ldots$ (subsets of $\mathcal{G}$)

(20) Predicates
For any n-place predicate P, P' is a relation over n plurals – i.e., $P' \subseteq [\wp(\mathcal{D})]^n$

(21) Terms v1.0
$x^g = g(x)$

(22) Formulas v1.0

$$\begin{array}{lll} G + [x] & = \{h : \exists g{\in}G\,(g[x]h)\} & \\ G + P(x,y,\ldots) & = \{g{\in}G : \langle x^g, y^g, \ldots\rangle{\in}P'\} & \\ G + \phi\,;\psi & = (G{+}\phi){+}\psi & \\ G + \neg\,\phi & = G & \text{iff } G{+}\phi = \varnothing \end{array}$$

where $g[x]h \Leftrightarrow g\backslash\{\langle x,g(x)\rangle\} = h\backslash\{\langle x,h(x)\rangle\}$

(23) Truth
A formula ϕ is true iff $\blacktriangleright{+}\phi \neq \varnothing$

PLUS works with two basic domains, $\mathcal{D}$ for individuals and $\mathcal{V}$ for variables. The domain of assignments, $\mathcal{G}$, is defined as the set of partial functions from $\mathcal{V}$ to $\mathcal{D}$. The domain of information states, $\mathfrak{G}$, is defined as the power set of $\mathcal{G}$ (sets of assignments). Predicates in PLUS are interpreted via the $'$ operator, returning a set of n-tuples for each n-place predicate as shown in (20). Thus, models in PLUS would be pairs $\langle\mathcal{D}, '\rangle$. Note that predicates are only defined over sets of individuals not individuals themselves – this will allow us to define plural predicates. Singular predicates will simply take singleton sets to represent singular values (and the set braces around such singletons will often be omitted below).

The only terms (arguments to predicates) in PLUS v1.0 are variables, which are interpreted relative to an assignment as shown in (21). The three basic formula types are random assignments $[x]$, literals $P(x,y,\ldots)$, conjunctions $\phi\,;\psi$, and negations $\neg\,\phi$. The denotations for these formulas are shown in (22), and their truth conditions are given in (23).

PLUS v1.0 is basically equivalent to DPL, so I will not go over it in detail here.

3.3. PLUS v2.0: Variable Sums

The first new machinery we will add to PLUS is the eponymous "+" operator, which retrieves all values in the information state for some particular variable. This requires a major change to our term interpretation and a slight adjustment to our literal formula interpretation:

(24) Terms v2.0

$$\begin{array}{ll} x^{g,G} & = g(x) \\ +x^{g,G} & = G(x) \quad \text{where } G(x) \stackrel{\text{def}}{=} \{g(x) : g{\in}G\} \end{array}$$

(25) Formulas v2.0 Same as v1.0 except:

$$G + P(t_1,t_2,\ldots) = \left\{g{\in}G : \langle t_1^{g,G}, t_2^{g,G}, \ldots\rangle{\in}P'\right\}$$

In short, we now interpret terms relative to both an assignment and an information state. There are two kinds of terms in PLUS v2.0: (plain) variables as before and variable sums written with a + before a variable. Only these new sums make use of the information state in their interpretation, denoting the set of all values for the given variable in the (assignments within the) given information state. An example is now in order, but first some helpful definitions:

(26) Helpful Abbreviations

a. $\blacktriangleright \stackrel{\text{def}}{=} \{\varnothing\}$

b. $\mathcal{G}_x \stackrel{\text{def}}{=} \blacktriangleright + \texttt{[}x\texttt{]}$, i.e. $\{x\} \rightarrow \wp(\mathcal{D})$, i.e. $\{\,[x \rightarrow X] : X \subseteq \mathcal{D}\,\}$

c. $P_x \stackrel{\text{def}}{=} \mathcal{G}_x + P(x)$, i.e. $\{x\} \rightarrow P'$

d. $\texttt{[}x\texttt{=}t\texttt{]} \stackrel{\text{def}}{=} \texttt{[}x\texttt{]}\,\texttt{;}\,x\texttt{=}t$

We've seen the starting information state ▶ before, but $\mathcal{G}_x$ is new: it denotes the result of just declaring the variable x, i.e., the set of all singleton assignments mapping x to some value in $\mathcal{D}$. And P_x is the result updating such a $\mathcal{G}_x$ with $P(x)$. Finally, we introduce an abbreviation for when we introduce variables.

We can now show the interpretation of the following formula:

(27) All the farmers gathered (on the field)
`[f]; farmer(f); gathered(+f)`

(28)
$$\begin{aligned}
&\blacktriangleright + \texttt{[f]}\\
&\quad = \{\,[\texttt{f} \rightarrow a] : a \in \mathcal{D}\,\}\\
&\quad = \mathcal{G}_{\texttt{f}}\\
&\blacktriangleright + \texttt{[f];farmer(f)}\\
&\quad = \mathcal{G}_{\texttt{f}} + \texttt{farmer(f)}\\
&\quad = \left\{\,[\texttt{f} \rightarrow a] : a \in \texttt{farmer}'\,\right\}\\
&\quad = \texttt{farmer}_{\texttt{f}}\\
&\blacktriangleright + \texttt{[f];farmer(f);gathered(+f)}\\
&\quad = \texttt{farmer}_{\texttt{f}} + \texttt{gathered(+f)}\\
&\quad = \left\{\,g \in \texttt{farmer}_{\texttt{f}} : \texttt{farmer}' \in \texttt{gathered}'\,\right\}\\
&\quad = \begin{cases} \texttt{farmer}_{\texttt{f}} & \text{if } \texttt{farmer}' \in \texttt{gathered}' \\ \varnothing & \text{otherwise} \end{cases}
\end{aligned}$$

Or more graphically:

(29)
$$\blacktriangleright \xrightarrow{\texttt{[f]}} \mathcal{G}_{\texttt{f}} \xrightarrow{\texttt{farmer(f)}} \texttt{farmer}_{\texttt{f}} \ldots$$
$$\ldots \xrightarrow{\texttt{gathered(+f)}} \texttt{farmer}_{\texttt{f}} \text{ iff } \texttt{farmer}' \in \texttt{gathered}'$$

The result of this derivation is simply $\texttt{farmer}_{\texttt{f}}$ (the set of all the smallest assignments that map f to a farmer) if all the farmers gathered on the field and $\varnothing$ otherwise.

We can do plurals and generalized quantifiers now, too. Note that I will use a convention that lowercase variables are only for singletons/singulars and uppercase variables only for plurals.

(30) a. Five women gathered together.

b. `[W]; FIVE(W); women(W); gathered(W)`

c. $\blacktriangleright \xrightarrow{\texttt{[W];FIVE(W)}} \texttt{FIVE}_{\texttt{W}} \xrightarrow{\texttt{women(W)}} \texttt{FIVE}_{\texttt{W}} \cap \texttt{women}_{\texttt{W}} \ldots$

$\ldots \xrightarrow{\texttt{gathered(W)}} \texttt{FIVE}_{\texttt{W}} \cap \texttt{women}_{\texttt{W}} \cap \texttt{gathered}_{\texttt{W}}$

This information state contains all the smallest assignments that map W to a set of five women who gathered together.

For simple quantifiers, we can store previous sums in plural variables:

(31) a. Most (of the) lawyers quit.

b. `[l];lawyer(l);[L=+l]; quit(l);[L'=+l]; MOST(L,L')`

c. $\blacktriangleright + \text{(b)} = \left\{ g \in \texttt{lawyer}_{\texttt{l}} \cap \texttt{quit}_{\texttt{l}} : g(\texttt{L}) = \texttt{lawyer}' \;\&\; g(\texttt{L'}) = \left(\texttt{lawyer}' \cap \texttt{quit}' \right) \right\}$

iff $\left| \texttt{lawyer}' \cap \texttt{quit}' \right| > \frac{1}{2} \left| \texttt{lawyer}' \right|$

This formula stores `+l` in plural variables twice: once in `L` after a formula representing the restriction *lawyers* and once again in `L'` after the nuclear scope *quit*. This strategy for quantifiers works here, but we will refine it below.

3.4. PLUS v3.1: Maximality

Some issues arise if we want to continue using sum variables inside quantifications:[3]

(32) a. A third of the students gathered (on the field).

b. `[s];student(s);[S=+s]; gathered(+s);[S'=+s];`
`ONE-THIRD(S,S')`

The attempted translation in (32b) for (32a) does not capture the correct truth conditions. In particular, the formula requires that all the students gathered, in which case `S'` would be

[3] Another possibility would be to use simple plural variables, with universal quantification (or equivalent) distributing over these plurals when necessary:

(i) a. Half the students (in my class) formed a rock band.

b. `[S];¬([s∈S];¬student(s)); [S'];formed-a-band(S'); HALF(S,S')`,

where `HALF(X,Y)` $\stackrel{\text{def}}{=}$ $Y \subseteq X$; $|Y| \approx |X|/2$

(ii) a. Half the band owned an instrument (of their own).

b. `[B];band(B); [B'];¬([b∈B];¬([i];instrument(i);own(b,i))); HALF(B,B')`

While this strategy gives us access to the restrictor set and the nuclear scope set, it blocks access to donkey anaphora and dependent sets, since they would be introduced under negation:

(iii) a. Almost every student who owns an instrument brought it to school.

b. `[S];¬([s∈S];¬(student(s);[i];instrument(i);owns(s,i)));`
`[S'];¬([s∈S'];¬brought(s,i); HALF(S,S'))`

(iv) a. Almost every student who owns an instrument brought them to school.

b. `[S];¬([s∈S];¬(student(s);[i];instrument(i);owns(s,i)));`
`[S'];brought(S',+i); ALMOST-ALL(S,S'))`

identical to `S`. However, the formula later requires `S'` to be one third of `S`, so it will never be true. Instead, a correct formula would assign to `S'` the largest group of students to gather on the field.

To solve this issue, PLUS v3.0 will introduce a maximality operator:

(33) $G + \texttt{<}\phi\texttt{>} = G_\phi + \phi$, where $G_\phi \stackrel{\text{def}}{=} \bigcup\{H \subseteq G : H + \phi \neq \varnothing\}$ [provisional]

Here G_ϕ is the largest subset of G that "satisfies" ϕ, i.e., does not yield $\varnothing$ when updated on ϕ. (This definition assumes this maximal subset contains all other satisfying subsets, but other definitions would work just as well.) The operator `<`ϕ`>` returns the result of updating this largest satisfying subset on ϕ. This lets us correctly capture the example above:

(34)
```
[s];student(s);[S=+s]; <gathered(+s)>;[S'=+s];
ONE-THIRD(S,S')
```

Now, the clause `<gathered(+s)>` does not require all students `s` to have gathered; instead, it restricts the information state G so that $G(s)$ contains the largest subset of students who gathered on the field.

Another issue we can solve via a refinement of our maximality operator is the fact that variables introduced under quantification ought not to be referred back to via (singular) pronouns outside of quantification:

(35) a. One third of the students gathered on the field. #She was cold.

b.
```
[s];student(s);[S=+s]; <gathered(+s)>;[S'=+s];
ONE-THIRD(S,S'); cold(s)
```

As PLUS stands, we are free to refer back to the quantificational variable `s` (as shown in (35b)) as if it were introduced by an indefinite. This does not seem to be allowed by natural language, though, as evidenced by the oddity of the second sentence in (35a).

To solve this issue, and simplify our formulas slightly, we will refine the maximality operator to "summarize" all the new variables introduced within its scope, replacing their individual values with their sum-variable values. These summarized values are appended to each assignment in the surrounding information state:[4]

(36) $G + \texttt{<}\phi\texttt{>} = \left\{ g \cup h : g \in G \;\&\; h = [\lambda x \notin dom(g).(G_\phi + \phi)(x)] \right\}$ [final]

The function h in the definition above takes any new variable x created in $G_\phi + \phi$ that were not in the original G. For such x, $h(x)$ returns the sum of all values for x in $G_\phi + \phi$, i.e., $(G_\phi + \phi)(x)$. The new information state returned by the maximality operator is the result of appending this h onto each g in the original G.

Thus defined, we can redo our translations so any variable introduced inside quantification will denote the sum of all its values inside its quantification when used outside its quantification.

[4]Technically, this should be

(i) $G + \texttt{<}\phi\texttt{>} = \left\{ g \cup h : g \in G \;\&\; h = \left[\lambda x \in \left(dom(G_\phi + \phi) \setminus dom(g) \right).(G_\phi + \phi)(x) \right] \right\}$

where $dom(G) \stackrel{\text{def}}{=} \bigcup\{ dom(g) : g \in G \}$

(Note that the variable `s'` is introduced in order to be summarized as the nuclear scope set for later use – this replaces the previous use of `S'`.)

(37) `<[s];student(s); <gathered(+s);[s'=s]>>; ONE-THIRD(s,s')`

Here, any later clause involving `s` or `s'` will necessarily need to be plural, since this variable will hold all students and all students who gathered, respectively. This explains the oddity of a later sentence like *She was cold*; this should instead be *They were cold.* On the other hand, dependent sets are quite easy to capture, since our new definition of the maximality operator automatically summarizes all new variables:

(38) a. Every student who wrote a paper turned it in. They were fascinating.

b.
```
<[s];student(s);[p];paper(p);wrote(s,p);
 <turned-in(s,p);[s'=s]>
>; EVERY(s,s'); fascinating(p)
```

3.5. PLUS v3.2: Distributivity

Another item that PLUS does not yet capture is that a discourse plural can actually depend on the value of another variable (and hence be dependent on the local assignment g):

(39) a. A professor in the department conducts loud experiments. A third of the students gathered in the chair's office to protest about him.

b.
```
[p];professor(p);loud(p);
<[s];student(s); <gathered-to-protest(+s,p); [s'=s]>;
ONE-THIRD(s,s')
```

Here we want different (summarized) `s'` for each possible value of `p`, but this is not possible, even with our maximality operators. The same issue arises even in cases with no sum variables internal to the quantification:

(40) a. A professor has recently retired. Most students of hers have been reassigned.

b.
```
[p];professor(p);retired(p);
<[s];student-of(s,p); <reassigned(s);[s'=s]>>;
MOST(s,s')
```

Here, summarized `s` (and therefore `s'`) should vary with the value of `p`, but it does not.

To solve this issue, we will introduce a distributive operator to be used in the translation of all indefinites:

(41) $G + \mathrm{D}x(\phi) = \bigcup\left\{ G_{x=g(x)} + \phi : g \in G \right\}$

This operator calculates $G+\phi$ separately for each value of x, before taking the union of all resulting information states. Note that $G_{x=g(x)}$ is the set of all $h \in G$ where $h(x)=g(x)$.

This operation is quite useful for our purposes, since the summarization inherent in any embedded maximality operator clauses will be performed separately for each value distributed over. For instance, consider the following translations for the two sentences above:

(42)
```
[p];Dp(professor(p);loud(p);
 <[s];student(s); <gathered-to-protest(+s,p);[s'=s]>>
); ONE-THIRD(s,s')
```

(43)
```
[p];Dp(professor(p);retired(p);
 <[s];student-of(s,p); <reassigned(s);[s'=s]>>
); MOST(s,s')
```

Due to the distribution over `p` in both cases above, the final summarized versions of `s` and `s'` are potentially different for different values of `p`.

This translation for indefinites also solves the inverse pronoun accessibility problem to the one introduced in the section above: a variable introduced by an indefinite at the top level of a formula should not allow subsequent sum variables:

(44) a. A woman was eating in a crowded cafeteria.
b. #They all left. [intended: all the women eating in the cafeteria left]

(45)
```
[w];woman(w);eating(w);in-cafeteria(w);left(+w)
```

Without translating the indefinite *a woman* using the distributive operator, the sentence in (44b) should be fine, as represented in (45). This is avoided, though, if every indefinite introduces a distributive operator:

(46)
```
[w];Dw(woman(w);eating(w);in-cafeteria(w);left(+w))
```

This formula does indeed allow the sum variable `+w`, but this sum simply returns a single value, since the component assignments of the information state have been partitioned according to their value for `w`.

4. Consequences

Notice that we have justified the PLUS logic solely on the basis of plurals and collective predicates. It turns out that internal discourse plurals (among other phenomena) will fall out of the system without further changes.

4.1. Internal Reference to the Discourse Plurals

First, we now have the machinery necessary to refer to discourse plurals within the quantifications that define them. For instance, here is an internal reference to a dependent set, the set of all donkeys owned by farmers who gathered them to graze:

(47) a. Most farmers who own a donkey gathered them on the field to graze.
b.
```
<[f];farmer(f); [d];Dd(donkey(d);owns(f,d));
 <gathered(f,+d);[f'=f]>>; MOST(f,f')
```

Notice that the scope of the distribution over donkeys doesn't extend past the restriction, so this does not impede the later clauses of the formula. In particular, `+d` above will denote all donkeys in assignments satisfying the nuclear scope, due to the maximality operator around the nuclear scope.

Similarly, we can now refer to nuclear scope sets internal to the nuclear scope as well. Note that I assume that the indefinite *a house...* in (48a) is an exceptional wide-scope indefinite, represented here by scoping its random assignment `[h]` above the quantification:

(48) a. Almost every friend of mine is one part-owner of a house they all share.

b.
```
[h];Dh(<[f];friend-of-mine(f);
 <house(h);part-owner(f,h);share(+f,h);[f'=f]>
>); ALMOST-ALL(f,f')
```

The `+f` above will represent all friends sharing house *h* as co-owners.

4.2. Bonus constructions

Certain other historically problematic readings can easily be captured in the system presented so far. For instance, PLUS can capture reciprocals, such as *each other*, using the same mechanism for internal reference to nuclear scope sets (`+s` in this example):

(49) a. Over half the students hated each other.

b. `<[s];student(s); <hated(s,+s\s);[s'=s]>>; OVER-HALF(s,s')`

where $(t_1 \backslash t_2)^{g,G} = (t_1^{g,G}) \backslash (t_2^{g,G})$

(For previous dynamic analyses, see Murray, 2007, 2008; Dotlačil, 2012.)

In addition, cumulative readings of modified numerals (Brasoveanu, 2012; Charlow, 2017) can be captured by assuming these DPs do not introduce distributive or maximality operators:

(50) a. Exactly three boys (total) saw exactly five movies (between them).

b. `[b];boy(b); ([m];movie(m);saw(b,m);FIVE(+m)); THREE(+b)`

Cumulative DPs of the form "$N\ \phi\ \psi$" translate as $[x];\phi;\psi;N(+x)$. I have placed parentheses around the translation of the nuclear scope of *exactly three boys* in (50b) in order to make this structure more clear. Without the maximality operator, the numerical restrictions on the sum variables are complete: `FIVE(+m)` limits all movies seen by a boy to total of exactly five and `THREE(+b)` requires there to be only three boys who saw a movie.

Cumulatives can also vary based on the value of previous indefinites. This is also well captured in the system:

(51) a. A famous film director (I know) is practically anonymous among his friends. Exactly three friends of his (total) have seen exactly five movies by him (total).

b.
```
[d];Dd(director(d);famous(d);anonymous-to-friends(d);
 [f];friend-of(f,d); ([m];movie-by(m,d);saw(f,m);FIVE(+m));
 THREE(+f) )
```

The cumulative is calculated as in (50), but separately for each possible such director. Inside the distributive `Dd(...)`, `+f` is only the friends of one specific `d` and `+m` only the movies by this `d` seen by one of his friends.

PLUS assigns reasonable translations to sentences involving *same* and *different*, too (Brasoveanu, 2011). We simply append a condition after their scope is complete. For *same* in (52), we can require that the total number of hats worn by students is one:

(52) a. Almost every student wore the same (type of) hat.

b.
```
<[s];student(s);
 <[h];Dh(hat(h);wore(s,h));ONE(+h);  [s'=s]>
>; ALMOST-ALL(s,s')
```

And for *different*, we can require the number of hats to be the same as the number of students, using our apparatus for internal reference to the nuclear scope set (presumably *different* is anaphoric to this set):

(53) a. Almost every student wore a different hat.

b.
```
<[s];student(s);
 <[h];Dh(hat(h);wore(s,h));|+h|=|+s|;[s'=s]>
>; ALMOST-ALL(s,s')
```

5. Conclusion

The machinery of PLUS was justified without reference to discourse plurals, and yet it correctly captures difficult cases involving such plurals, including internal reference to nuclear scope and dependent sets. Furthermore, once this internal reference is possible, other phenomena get straightforward analyses using the same machinery. Finally, the results here were achieved without using sets of assignments as states (only as information states). The update semantics lets us capture much of the same phenomena with these lower order data structures.

The system presented above does have one major failing versus existing plural logics: it cannot handle quantificational subordination, due to the "summarization" operation in the maximality operator. I have separately been working on a system to handle this in a similar framework, though, where new information states are simply appended to old ones, saving these previous states for reference in quantificational subordination (among other phenomena). Please see Keshet (2019) for details.[5]

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Strong beliefs, weak commitments[1]

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Abstract. The standard Hintikkan semantics views *believe* as a universal quantifier over possible worlds (Hintikka, 1969). This semantics (i) fails to capture the fact that *believe* is gradable (cf. *partially believe* or *fully believe*) and (ii) makes no predictions about the degree of certainty of the belief agent toward the prejacent. To remedy these problems, I propose a scalar semantics along the lines of Kennedy and McNally's (2005) analysis of gradable adjectives, arguing that *believe* is a maximum-degree predicate. While belief attributions are sometimes interpreted as hedges (e.g., *I believe it's raining* can be taken as a statement of uncertainty), I point out that such uses are restricted to contexts in which the belief component is not relevant to the question under discussion. Following up on a suggestion made in Chemla (2008), I propose that the weak sense of *believe* arises as an antipresupposition, a scalar inference derived through competition with a presuppositionally stronger *know*-competitor. Contra Hawthorne et al. (2016), I argue that the intuition of weakness is due not to reduced modal force but rather to the subjectivity of modal content, amounting to a situation in which the agent has full subjective confidence in the prejacent but fails to publicly commit to it.

Keywords: belief, modality, gradability, subjectivity v. objectivity, antipresupposition, questions under discussion.

1. The Hintikkan orthodoxy and its problems

The verb *believe* plays a pivotal role in semantic research as it underlies a number of widely studied phenomena, e.g., opacity, presupposition projection, neg-raising, the norms of assertion, etc. It is then crucial to understand its core interpretational properties. In formal semantics, it has become standard to analyze *believe* as a universal quantifier over possible worlds. Ever since Hintikka (1969), a belief attribution is taken to state that the **prejacent** (=the embedded proposition) is true in all of the agent's doxastic alternatives. This is usually rendered as follows, where $Dox_{x,w}$ stands for the set of x's doxastic alternatives in w, i.e., the set of possible worlds compatible with everything x believes in w.

(1) $[\![\text{believe}]\!]^w = \lambda p \lambda x . \forall w' \in Dox_{x,w} : p(w')$

Though very popular, this Hintikkan orthodoxy fails on at least two counts.

- Gradability: *Believe* is a gradable predicate, as evidenced by its ability to tolerate degree modification (cf. *partially believe* or *fully believe*). But it remains unclear how this gradability property can be modeled if the force of *believe* is fixed by a quantifier once and for all. Ideally, the strength of *believe* should be able to be manipulated the same way degree morphology manipulates the degree argument of gradable adjectives. Yet a simple quantificational semantics does not supply a degree argument.

[1]I would like to thank Danny Fox, Louise McNally, Maša Močnik, Roger Schwarzschild, and the audiences at *SuB*, the University of Cologne, the University of Konstanz, and MIT. For English judgments, I am indebted to Kurt Erbach, James Griffiths, Kyle Rawlins, and Peter Sutton.

- Commitment strength: The standard semantics makes no predictions as to how strongly unmodified uses of *believe* commit its agent to the prejacent. Does *Fred believes it's raining* require that Fred is certain it is raining or just that Fred finds it likely it is raining? The lexical entry above states that all doxastic alternatives are worlds in which the prejacent is true. But universal force alone does not entail a specific degree of certainty without a clear idea of how the agent is linked to the domain of quantification. Since the set of doxastic alternatives is defined as the set of worlds compatible with everything the agent "believes" in the world of evaluation, the issue of commitment strength is but shifted to the metalanguage. It is not derived and needs to be stipulated.

Quite surprisingly, these two issues have rarely been put on the table in formal semantics, although similar questions about modal adjectives have been discussed in work on graded modality (Kratzer, 1991; Portner, 2009; von Fintel and Gillies, 2010; Yalcin, 2010; Klecha, 2014; Lassiter, 2017). The gradability issue can be addressed if the semantics of *believe* is recast in a degree-based framework as the one developed in Cresswell (1976), von Stechow (1984), Kennedy (1999), Kennedy and McNally (2005), a.o. Doing so appears to posit less of a challenge and the first steps in this direction have already been made (e.g., Lassiter, 2017; Santorio and Romoli, 2017). The commitment strength issue, however, has barely been touched upon in the literature, with the notable exception of Hawthorne et al. (2016). Deciding on the strength of *believe* turns out to be a challenging task, and the bulk of this paper will be devoted to providing a plausible answer.

Is *believe* weak or strong? The empirical picture appears to be varied right off the bat. For example, an utterance of (2) can be taken as a description of certainty or as a hedge toward the embedded proposition, depending on the context. The former (strong) reading will be brought out if we are playing a game where everyone is required to list some of their beliefs. The latter (weak) reading may come about if we are making guesses about who the next president of the U.S. is going to be.

(2) I believe Oprah will win the next election.

Given this flexibility, there are two plausible views on the strength of *believe*. The first view is that this verb implies full certainty, i.e., the agent regards the embedded proposition as true. I call this view **Strong Believers** (SB) and state it more formally as in (3). Here $Cr_x(p)$ stands for x's credence (or subjective confidence) in p.

(3) Strong Believers
$[\![\text{believe}]\!](p)(x)$ iff $Cr_x(p) = 1$

Though rarely articulated, SB seems to be what has been implicitly assumed all along. For example, in a rare moment of explicitness, Lasersohn (2005: 675) states: "To believe something is to consider it true." SB appears to be the prevalent view in philosophy as well (e.g., Levi, 1991; Williamson, 2002; Clark, 2013).

The second view is what I call **Weak Believers** (WB). This view states that the subjective probability associated with believe exceeds some contextually specified threshold, which would typically be 50% but can be significantly influenced by the context.

(4) Weak Believers
$[\![\text{believe}]\!](p)(x)$ iff $Cr_x(p) > \theta_{bel}$

WB is defended in Hawthorne et al. (2016), who offer a number of empirical arguments in its support (see also Foley, 1992; Lauer, 2017). I address these arguments in section 2, along with a range of fresh data that argue against this view.

It is also possible to claim that *believe* is lexically ambiguous between a weak and a strong interpretation, so that both WB and SB are valid. I have two worries about such a proposal, one conceptual and one empirical. The conceptual worry stems from the fact that the alleged readings are logically dependent, as the stronger entails the weaker. This way of cutting the meaning pie is hardly theoretically parsimonious and it is unclear how the language learner can acquire such a distinction. The empirical worry is that under an ambiguity approach, one would expect *I believe*$_{weak}$ *he is going to win but I don't believe*$_{strong}$ *he will* to be as felicitous as *It's likely he is going to win but it's not certain*. In reality, the latter sentence is acceptable while the former sentence sounds contradictory. Given these obvious difficulties, I see no merit in pursuing the ambiguity approach any further.

The main claim of this paper is that *believe* is a maximum-degree gradable modal. This means that *believe* makes available a degree argument that can be manipulated by degree morphology, yet in the absence of (overt) degree morphology it refers to the top of the scale. Crucially, *believe* differs from modal adjectives like *certain* or *sure* in that it encodes a measure of subjective rather than objective probabilities (hence the use of a credence function in (3)-(4) above). In other words, *believe* is subjective but strong: the agent regards the prejacent as true but may lack sufficient evidence for it. This opens up the possibility that a belief agent has full confidence in the prejacent but does not want to go on record and publicly endorse it, thus giving rise to the intuition of weakness. I will argue that the intuition of weakness arises as an antipresupposition, i.e., a kind of scalar inference derived through competition with a presuppositionally stronger *know*-competitor. While this view supports SB over WB, it also emphasizes the idea that the perceived weakness of *believe* is not tied to its modal force but rather to its modal content. Once we acknowledge that *believe* invokes subjective certainty, we can have an explanation for why it behaves as a strong modal throughout while at the same can serve as a hedge. The hedging use does not weaken its strong subjective force but rather hints at the lack of objective certainty.

The structure of the paper is as follows. Section 2 lays out the empirical landscape on the gradability and the strong nature of *believe*. Section 3 develops a scalar semantics for *believe*, one that derives its gradability, its closure under conjunction, and its strong force, yet leaves the door open to hedging uses. Section 4 is the conclusion.

2. The empirical picture

This section sifts through five sets of data that furnish converging evidence in favor of viewing *believe* as a gradable predicate that takes a maximum-degree standard. Most importantly, I demonstrate that the weak interpretational component becomes visible only when brought to the fore by contextual factors.

2.1. Gradability

Believe is a gradable predicate. It can participate in comparative (5) and equative constructions (6) (if mediated through gradable adverbs like *strongly*), and can be directly modified by minimality (7), maximality (8), and proportional modifiers (9). (All examples below are culled from the web.)

(5) a. He believes more strongly than I do that the organization of the executive branch of the federal government matters a great deal.
b. Men believe less strongly than women that they have control over their future health or that personal actions contribute to good health.

(6) Each [farmer] believes as strongly as the other that his crops will not survive another week without water, and each cares as much as the other about the survival of his crops.

(7) Atticus partially believes that prejudice exists because people do not understand each other [...].

(8) a. I strongly believe that life is too short to eat mediocre meals.
b. Darwin says he almost believes that species are not immutable.
c. Theresa fully believes that we all have the inner ability to achieve what we desire and sometimes it takes input from others to kick start that process.
d. I truly believe, 100 percent, that for every person reading this article, I can go one by one and determine your potential for success by looking at only two basic principles.

(9) a. One possibility is that Charles half believes that there is a real danger, and that he is, literally, at least half afraid.
b. This has taken me lots of research to come to this conclusion, but I believe 95 percent that it is.

The fact that *believe* is gradable does not prejudge the choice between SB and WB, i.e., the question of whether an unmodified use of *believe* implies full or partial certainty. The reason is that – when occurring outside a degree construction – gradable predicates may pick different standards of comparison. Unger (1971) was the first to distinguish between two kinds of gradable adjectives, depending on how the standard is chosen. The standard for **relative** adjectives like *tall* is selected contextually (typically taken from the middle of the scale), while the standard for **absolute** adjectives like *bent*, *certain*, *full* is fixed as the minimum or the maximum of the scale. Kennedy and McNally (2005) and Kennedy (2007) convincingly argue that the relative/absolute distinction boils down to differences in scale structure. They classify gradable predicates depending on whether the associated scale is open or closed on its ends, producing the following typology.

(10)	a.	totally open scale	○——————○	*tall*, *short*
	b.	lower-closed upper-open scale	●——————○	*bent*, *straight*
	c.	lower-open upper-closed scale	○——————●	*certain*, *uncertain*
	d.	totally closed scale	●——————●	*full*, *empty*

This scale typology is empirically supported by the distribution of degree modifiers. Thus, proportional modifiers (e.g., *half* or *mostly*) are only acceptable with adjectives encoding totally closed scales; maximum-degree modifiers (e.g., *perfectly*) are only compatible with adjectives encoding upper-closed or totally closed scales; and minimum-degree modifiers (e.g., *slightly*) can only occur with adjectives encoding lower-closed or totally closed scales.

Kennedy and McNally draw the following important generalization: in their unmarked or "positive" form, adjectives associated with totally open scales take relative standards while adjectives associated with partially or totally closed scales take absolute standards. For example, *tall* is associated with a totally open scale (it cannot occur with minimality or maximality modifiers like *slightly* or *completely*, at least not without coercion) and takes a relative standard (what counts as tall will depend on the comparison class at hand). By contrast, *full* has an upper-closed scale (things can be said to be completely full) and takes the maximal degree of the scale as its standard (a bottle is said to be full if it cannot accept more liquid, modulo pragmatic slack).[2]

Given the possibility for independently probing into scalar structure, we can use the Kennedy/McNally generalization to assess whether *believe* is a relative or an absolute predicate. What kind of scale is *believe* associated with? The data in (5)-(9) clearly argue for a totally closed scale, due to the compatibility with minimum, maximum, and proportional modifiers. I will thus assume that *believe* has the ratio scale [0, 1], which it shares with probability measures. Since its scale is totally closed, the Kennedy/McNally generalization predicts that *believe* picks out an absolute rather than a relative standard. This prediction is in line with SB, which entails an absolute standard of 1 (full subjective certainty), but not compatible with WB, which does not set a fixed standard. We can conclude that *believe* takes an absolute standard, not a relative one.

2.2. Missing quantity implicatures

WB and SB make different predictions about potential quantity implicatures associated with unmodified belief sentences. If *believe* is weak, its use is expected to routinely trigger implicatures to the effect that the agent has doubts about the prejacent. By contrast, if *believe* is strong, no generation of such implicatures is predicted. The lack of systematic quantity implicatures associated with belief attributions in either root or embedded positions is a first hint that the latter view is more on the right track.[3]

(11) a. Kamala believes that America needs universal health care.
b. $\not\rightsquigarrow$ Kamala is not (fully) convinced that America needs universal health care.

[2] The explanation for the first part of Kennedy and McNally's generalization is straightforward: if a scale lacks endpoints, an adjective associated with it needs contextual support in order to find an appropriate standard. The explanation for the second part of the generalization requires an additional optimization principle. Kennedy (2007) thus invokes Interpretive Economy, according to which truth conditions favor conventional meaning over context. Given this principle, if a scale provides endpoints, an adjective must use these when picking a standard before it looks for it elsewhere, i.e., before it involves the context.

[3] In these examples the putative implicature associated with *x believes p* is rendered as *x is not convinced that p* rather than, say, as *x is not certain that p*. The reason is that, according to the current proposal, *believe* encodes a subjective measure, and *convinced* seems to share this property with it. While *x believes p but is not certain that p* is fully natural, I argue that *certain* (unlike *believe*) is associated with an objective measure and the contrast established in sentences of this shape is about the degree of public commitment rather than modal force (see subsection 3.3 for details).

(12) a. According to the press, Kamala believes that America needs universal health care.
b. $\not\rightsquigarrow$ According to the press, Kamala is not (fully) convinced that America needs universal health care.

Attributing belief to attitude holders whose subjective certainty level is fixed by the context also recommends SB over WB. Under a weak story, the utterance in (13) should be ruled out as underinformative, and yet it is judged to be felicitous. Conversely, (14) demonstrates that it is hard to sincerely attribute belief to an agent who doubts the prejacent to some degree. WB lets us expect that the suggested inference can be drawn, given that the attitude holder finds the prejacent likely to be true. By contrast, SB blocks this inference due to lack of full (subjective) certainty.

(13) *Context: We don't know whether the transfer student passed the midterm but Jill has no doubts he did.*
Jill believes the transfer student passed the midterm.

(14) Mueller finds it likely but still has some doubts that Russia influenced the election. #So, Mueller believes that the Russians did it.

The last kind of data I discuss in this subsection involves scalar gradation. If *believe* is strong, it should be able to strengthen a weaker modal with the same content but it should not allow for itself to be further strengthened by a stronger modal with the same content. Starting with the former prediction, Hawthorne et al. (2016: 1398) observe that *believe* cannot strengthen *think*, which they view as weak.

(15) ??Tim thinks it's raining, but he doesn't believe that it is.

However, I see no reason not to adopt the view that *think* is as strong as *believe*. After all, the two verbs are nearly synonymous and have a similar distribution, with the important caveat that *think* is not gradable (cf. **partially think* or **fully think*). If this on the right track, *think* is strong but subjective, so (15) is expected to be out. (A lexical entry for *think* that has this profile is given in subsection 3.1.)

Perhaps the most well-known objection to the second prediction is the old dictum that knowledge entails belief (but not vice versa), supported by natural gradations as in the following example.

(16) Scientists believe there is water on Mars. In fact, they know it.

However, it has also been argued that while *know* is stronger than *believe* in terms of its presuppositions and perhaps in terms of content as well, it is not stronger in force (see Chemla, 2008; Sauerland, 2008; Schlenker, 2012). *Know* is presuppositionally stronger in that it adds the factive inference that the prejacent is true and it may also be truth-conditionally stronger in that it entails that the attitude holder has appropriate evidence for the prejacent. Either property could be invoked to explain the felicitous gradation above without ascribing a raised subjective certainty to the agent. To put it differently, the modal gradation above need not raise the likelihood of the prejacent from the point of view of the attitude agents; it may do so merely from the point of view of the speaker.

2.3. Closure under conjunction

One difference between strong and non-strong modals concerns the way they interact with conjunction. Strong modals are closed under conjunction, i.e., they license the entailment in (17), where M ranges over modals and p, q range over propositions. This is illustrated in (18). Non-strong modals, on the other hand, do not have this property, see (19)-(20).

(17) $M(p) \wedge M(q) \models M(p \wedge q)$

(18) a. It's certain that Sean is in Rome and it's certain that he is catholic.
b. $\models$ It's certain that Sean is in Rome and that he is catholic.

(19) *Each week Jack spends (in no particular order) 3 nights at the local pub and gets drunk, 2 nights at the same pub but stays sober, and 2 nights at home where he also gets drunk. On a given night, I say:*
a. Jack is probably at the pub. True (chance = 5/7)
b. Jack is probably drunk. True (chance = 5/7)
c. Jack is probably at the pub drunk. False (chance = 3/7)

(20) a. It's possible Jane is in Italy and it's also possible Jane is in France.
b. $\not\models$ It's possible Jane is in Italy and in France.

Since (21) presents a valid entailment, *believe* pairs up with strong modals in this respect. Notice that even a hedged reading of *believe* licenses this type of inference (22). This fact suggests that the intuition of weakness does not translate into non-strong modal force.

(21) a. Ron believes Mia is hawt and he also believes she is going to marry him.
b. $\models$ Ron believes that Mia is hawt and that she is going to marry him.

(22) a. I believe Sean is catholic, but I'm not sure.
b. I believe Sean is in Rome, but I'm not sure.
c. $\models$ I believe Sean is catholic and he is Rome, but I'm not sure.

There is a lot of discussion in the philosophical literature about whether the beliefs of a rational agent are closed under conjunction. While most philosophers agree this should be so (e.g., Hintikka, 1962; Levi, 1973; Leitgeb, 2014), detractors point out that the closure property leads to the **lottery paradox** (Kyburg, 1961; Foley, 1992). A classical version of the lottery paradox for rational belief goes as follows. Consider a fair lottery with 100 tickets and one winner. It seems rational to believe the statement "Ticket #1 will not win", as it has a solid 99% chance of being true. But the same goes for the statements "Ticket #2 will not win", "Ticket #3 will not win", and so on down the line up to "Ticket #100 will not win". By the closure property, it should then be rational to believe the statement "No ticket will win". But this contradicts the assumption that one ticket will win.

The important thing to notice here is that the lottery paradox is about the norms of rational belief rather than the semantics of the verb *believe* per se. If rational belief is understood as reaching some high but non-maximal level of confidence, it is indeed reasonable to reject the closure property. However, when the paradox is brought to bear on the use of the verb *believe*, the linguistic judgments can be disputed, as Hawthorne et al. (2016) themselves admit. In the lottery scenario, it may not be entirely sincere to assert that one believes that one's ticket will lose based on numeric probabilities alone. Indeed, if we assume that *believe* is strong, any shortage of (subjective) certainty would make the premises false and the paradox would not arise.

2.4. Neg-raising and modal strength

Neg-raising is a phenomenon whereby a matrix negation is interpreted as if it takes scope inside an embedded clause, so that *x doesn't believe p* comes to mean *x believes not p* (Bartsch, 1973; Horn, 1989; Gajewski, 2007; Romoli, 2013; Homer, 2015). While there is no universally accepted analysis of neg-raising, semantic accounts typically cash in on Bartsch's "excluded middle" principle, according to which the agent holds the described attitude towards the embedded proposition or its negation. Thus, if *x doesn't believe p* is uttered and *x believes p* $\vee$ *x believes not p* is assumed to hold, we can conclude *x believes not p*, since the assertion is only compatible with the second disjunct of the excluded middle principle. The strengthened neg-raised reading of the original utterance is now derived.

Since *believe* is a neg-raising predicate, a legitimate question to ask is what other predicates fall in the same class and whether there are generalizations to be drawn about its members. Hawthorne et al. (2016) hypothesize that neg-raising occurs with weak modal predicates (e.g., *think*, *want*, *like*, *advise*) but not with strong modal predicates (e.g., *know*, *need*, *love*, *order*). The fact that *believe* shares this property with the former group, they argue, bespeaks a weak semantics.

However, a closer look reveals that the alleged link between weak modal force and neg-raising is not supported by the data. Horn (1989: ch.5) draws a distinction between three types of modals depending on their perceived strength: weak scalars (e.g., *possible*, *allowed*), mid-scalars (e.g., *likely*), and strong scalars (e.g., *certain*, *necessary*). Taking into consideration the crosslinguistic picture, he goes on to show that weak scalars never license neg-raising, mid-scalars typically do, and strong scalars may or may not license it. Thus, with the exception of weak scalars, modal strength is not a reliable indicator of neg-raising behavior. Notice, for example, that *want* is a neg-raising predicate while *desire* is not (Gajewski, 2007), but it is not obvious at all that the two verbs differ in strength. Thus, the fact that *believe* licenses neg-raising does not decide on its modal strength, except for excluding the possibility that it is a weak scalar.

2.5. Hedging

The main challenge to SB stems from the observation that a statement of belief can be used as a hedging device. The belief agent below explicitly disavows responsibility for the truth of the prejacent.[4]

(23) I believe it's raining, but I'm not sure it's raining. (Hawthorne et al., 2016)

[4] As Hawthorne et al. (2016) point out, some English speakers have a preference for *think* over *believe* in these examples, which could significantly weaken their argument. However, my impression is that most speakers do accept hedging examples like these, at least as root sentences. In embedded positions, such structures may be less acceptable (cf. ?*Suppose I believe it's raining but I'm not sure*).

I will argue below that such examples do not put into question the strong force of *believe* because all they do is establish a contrast between privately held convictions and publicly expressed commitments. Under this view, (23) means somethings like "The speaker is fully confident that it is raining but she does not want to publicly commit to it (presumably because she lacks sufficient evidence)". Once we acknowledge that doxastics like *believe* or *think* differ from modal adjectives like *certain* or *sure* in that the former invoke subjective certainty, we can understand why a strong subjective modal can be used as a hedge on the objective certainty of the agent.

It is important to point out that the hedging use comes with relevance restrictions on it. Hedging uses turn out to be sensitive to what the conversation is about, or the **question under discussion** (Ginzburg, 1996, 2012; Roberts, 1996; Büring, 2003; Farkas and Bruce, 2010). As the data below shows, the intuition of weakness arises when the prejacent (rather than the belief component) is at issue (24). When what is at issue is the belief component itself, the weak component of *believe* is difficult to access (25).

(24) {Is capitalism better than socialism?}
I believe so (but I'm not sure).

(25) {Tell us about your political beliefs.}
I believe capitalism is better than socialism (?but I'm not sure).

In summary, we see that in order for *believe* to appear weak, the belief attribution itself must not be relevant in the current discourse. This observation suggests that the intuition of weakness should not be baked into the lexical entry of this verb. The weak component is more likely a by-product of the way this verb interacts with contextual factors.

3. A strong, scalar, and subjective semantics for *believe*

Given the discussion in the previous section, we need a semantics that derives the following facts.

- *Believe* is gradable; its strength can be manipulated by degree modifiers like *partially*, *truly*, or *95 percent*. In its unmodified use, it is an absolute predicate that takes a maximum-degree standard.
- *Believe* is closed under conjunction with respect to its internal argument: *x believes p* and *x believes q* jointly entail *x believes* (*p and q*).
- Being maximum degree, *believe* is strong: an unmodified use entails full certainty on the part on the attitude holder. At the same time, the implied commitments can be weak, provided that the belief component is not relevant to the question under discussion.

This section offers a strong semantics for *believe* that allows for degree modification, entails the closure property, and derives the intuition of weakness as a particular kind of a scalar inference.

3.1. *Believe* as maximum degree

In order to capture the gradability of *believe*, I follow the approach to gradable adjectives proposed in Cresswell (1976), von Stechow (1984), Kennedy (1999), Kennedy and McNally (2005), and extended to modal adjectives in Lassiter (2017) and Santorio and Romoli (2017). The entry below states that the belief agent's credence in the prejacent meets some threshold, where *Cr* is a credence function and *p*, *d*, *x* are variables over propositions, degrees, and individuals (respectively).[5]

(26) $[\![\text{believe}]\!] = \lambda p \lambda d \lambda x \,.\, Cr_x(p) \geq d$

There are several important things to notice about this meaning. The first is that *believe* expresses credences, i.e., subjective probabilities. This will be important in subsection 3.3 in order to ensure that *believe* can tolerate weak public commitments. The proposed semantics also entails that *believe* is associated with the probabilistic scale [0, 1], which is fully closed (see subsection 2.1 for empirical arguments). Given Kennedy's (2007) principle of Interpretive Economy (mentioned in footnote 2 above), we predict that *believe* is an absolute predicate. Finally, notice that the degree argument is filled after the propositional argument. While degree arguments may be assumed to be fed in different orders, setting things up this way will allow us to maintain single lexical entries for degree modifiers that work across the adjectival and the verbal domain.

The degree argument of gradable adjectives is always filled by degree morphology. For positive forms, where no overt degree morpheme is present, it has been assumed that the norm of comparison is supplied by a covert morpheme called *pos*. Cresswell (1976), who pioneered this idea, assumed that *pos* contributes something like "more than average", so that *Bill is tall* comes to mean that Bill is of an above average height. I thus assume the following semantics for *pos* (adopted from Kennedy and McNally, 2005), where *C* is a contextually supplied comparison class of appropriate objects.

(27) $[\![pos]\!]^C = \lambda P \lambda x \,.\, \exists d[\mathbf{standard}(d,P,C) \wedge P(d)(x)]$

Kennedy and McNally (2005) suggest that the first conjunct in the above formula links the degree argument to the right type of standard depending on the features of the selected predicate and relative to a comparison class. This conjunct is spelled out as follows, assuming that μ_P is the measure function associated with P and s_P is the scale associated with P.

(28) $$\mathbf{standard}(d,P,C) = \begin{cases} d > \mathbf{avg}\{\mu_P(x) \mid x \in C\} & \text{if } P \text{ is relative} \\ d > \mathbf{min}(s_P) & \text{if } P \text{ is minimum degree} \\ d = \mathbf{max}(s_P) & \text{if } P \text{ is maximum degree} \end{cases}$$

The standard norm for relative adjectives is context sensitive; it is the average degree of *P*-ness of the objects inside some contextually specified comparison class. By contrast, the standard norms for absolute adjectives do not depend on the facts in the world. They are fixed as the minimum or the maximum of the relevant scale.

Let us assume that *pos* attaches to unmodified VPs headed by *believe*, as below. Since in this

[5] Following up on the discussion in subsection 2.2, I suggest that *think* has a similar semantics but lacks a degree argument: $[\![\text{think}]\!] = \lambda p \lambda x \,.\, Cr_x(p) = 1$.

case *pos* equates the degree of belief to the maximum of the probability scale (=1), we derive the fact that unmodified *believe* is strong.

(29) *pos* [believes it's raining]
a. $[\![\text{believes it's raining}]\!] = \lambda d\lambda x\,.\,Cr_x([\![\text{rain}]\!]) \geq d$
b. $[\![\textit{pos}\,[\text{believes it's raining}]]\!] = \lambda x\,.\,\exists d[d = 1 \wedge Cr_x([\![\text{rain}]\!]) \geq d]$
$= \lambda x\,.\,Cr_x([\![\text{rain}]\!]) = 1$

We can adopt the same kind of meanings for overt degree modifiers that usually combine with gradable adjectives. The following lexical entries are modeled on Kennedy and McNally (2005) and preserve the logical types. For presentation purposes, I take one instance of minimality, maximality, and proportional modifiers each.

(30) a. $[\![\text{partially}]\!] = \lambda P\lambda x\,.\,\exists d[d > \mathbf{min}(s_P) \wedge P(d)(x)]$
b. $[\![\text{truly}]\!] = \lambda P\lambda x\,.\,\exists d[d = \mathbf{max}(s_P) \wedge P(d)(x)]$
c. $[\![\text{95 percent}]\!] = \lambda P\lambda x\,.\,\exists d[d = 0.95 \wedge P(d)(x)]$

For example, belief sentences with minimality modifiers like *partially* give rise to the meaning composition shown below.

(31) partially [believes eating pizza is healthy]
a. $[\![\text{believes eating pizza is healthy}]\!] = \lambda d\lambda x\,.\,Cr_x([\![\text{eat pizza healthy}]\!]) \geq d$
b. $[\![\text{partially [believes eating pizza is healthy]}]\!]$
$= \lambda x\,.\,\exists d[d > 0 \wedge Cr_x([\![\text{eat pizza healthy}]\!]) \geq d]$
$= \lambda x\,.\,Cr_x([\![\text{eat pizza healthy}]\!]) > 0$

Comparative morphology in belief sentences is more challenging. The reason is that *believe* does not directly compose with comparative morphemes the way gradable adjectives or verbs like *love* or *hate* do. Instead, beliefs are juxtaposed by comparative forms of gradable adverbs like *strongly*. This necessitates additional entries for degree modifiers that compose with adverbs rather than adjectives. To show how this can be done, let us first posit the following semantically bleached meaning for *strongly*.

(32) $[\![\text{strongly}]\!] = \lambda P\lambda d\lambda x\,.\,P(d)(x)$

The "strong" meaning of unmodified *strongly* comes not from the adverb itself but from the fact that it composes with an adverbial version of *pos*. This is demonstrated below, where d_s is the relevant threshold for beliefs that count as strong.

(33) $[\![pos_{Adv}]\!]^C = \lambda A\lambda P\lambda x\,.\,\exists d[\mathbf{standard}(d,P,C) \wedge A(P)(d)(x)]$

(34) [pos_{Adv} strongly] [believes S]
a. $[\![pos_{Adv}\ \text{strongly}]\!]^C = \lambda P\lambda x\,.\,\exists d[\mathbf{standard}(d,P,C) \wedge P(d)(x)]$
b. $[\![\text{believes } S]\!] = \lambda d\lambda x\,.\,Cr_x([\![S]\!]) \geq d$
c. $[\![[pos_{Adv}\ \text{strongly}]\ [\text{believes } S]]\!] = \lambda x\,.\,\exists d[d > d_s \wedge Cr_x([\![S]\!]) \geq d]$
$= \lambda x\,.\,Cr_x([\![S]\!]) > d_s$

A standard meaning for adjectival *more* is given in (35a); here d' is filled by the degree denoted by the comparative clause (Kennedy, 1999). The adverbial counterpart in (35b) makes room for an additional argument supplied by the gradable adverb.

(35) a. $[\![\text{more}]\!] = \lambda d' \lambda P \lambda x \,.\, \exists d[P(d)(x) \wedge d > d']$
b. $[\![\text{more}_{Adv}]\!] = \lambda A \lambda d' \lambda P \lambda x \,.\, \exists d[A(P)(d)(x) \wedge d > d']$

Assuming the elliptical structure in (36), we can derive comparative uses involving *believe* as follows.

(36) John [believes *S*] [[more$_{Adv}$ strongly] [than Mary ~~believes *S*~~]]
a. $[\![\text{more}_{Adv}\,\text{strongly}]\!] = \lambda d' \lambda P \lambda x \,.\, \exists d[P(d)(x) \wedge d > d']$
b. $[\![\text{than Mary believes } S]\!] = d_c$
c. $[\![[\text{more}_{Adv}\,\text{strongly}]\ [\text{than Mary believes } S]]\!] = \lambda P \lambda x \,.\, \exists d[P(d)(x) \wedge d > d_c]$
d. $[\![[\text{believes } S]\ [[\text{more}_{Adv}\,\text{strongly}]\ [\text{than Mary believes } S]]]\!]$
$= \lambda x \,.\, \exists d[Cr_x([\![S]\!]) \geq d \wedge d > d_c]$
$= \lambda x \,.\, Cr_x([\![S]\!]) > d_c$

This should suffice to demonstrate the general plausibility of treating *believe* as a gradable verb. Needless to say, what has been presented in this subsection is just an outline of a rich and very complex phenomenon. But it is promising that it already provides the basic functionality and is well incorporated into the degree-based framework of gradability.

3.2. Conjunction closure

One desirable consequence of the current account is that *believe* is closed under conjunction. To see that, assume that *x believes p* and *x believes q* are both true. Given the proposal developed in the previous subsection, it follows that $Cr_x(p) = 1$ and $Cr_x(q) = 1$. These statements say that, according to x, the entire probability weight falls within p and the entire probability weight falls within q. That is, according to x, all possible worlds outside p and outside q are assigned a probability of zero. This entails that $Cr_x(p \cap q) = 1$, i.e., *x believes* $($*p and q*$)$ is true. Given the empirical data discussed in subsection 2.3, this is a welcome result.

3.3. Explaining hedging

If *believe* entails full confidence in the prejacent, as the bulk of the empirical evidence presented in section 2 suggests, how can we reconcile this with the possibility of hedging? I argue that the intuition of weakness falls out as a particular kind of scalar inference that arises through competition with a presuppositionally stronger *know*-alternative. In order to understand why this inference to weakness does not clash with the full strength of *believe*, we need to draw a distinction between two types of certainty, i.e., subjective and objective. **Subjective** certainty is what is expressed in belief reports; it is privately held and need not be based on empirical evidence. By contrast, **objective** certainty is publicly expressed and needs to be backed up by evidence. This is the kind of certainty that is at stake in conversation, as it entails commitments and carries with it the burden of proof. Subjective certainty is measured by the probability function *Cr*, already introduced above. Objective certainty, I assume, is measured by the function *Pr*. One can think of *Pr* as a more conservative version of *Cr*, although this will only hold for sincere speakers. That is, if a speaker is publicly committed to a proposition to a certain degree, her subjective confidence in that proposition will normally meet that degree: $Pr_x(p) \leq Cr_x(p)$, for all sincere agents x and propositions p.[6]

I now discuss the nature of the scalar inference that is responsible for the intuition of weakness. Hawkins (1991), following along the classical analysis of Russell (1905), proposed that *the* and *a(n)* share an entailment of existence but *the* additionally introduces an implication of uniqueness. Hawkins assumed that this uniqueness implication is a regular entailment, so that $\langle$*a(n)*, *the*$\rangle$ constitutes an entailment-based lexical scale or an **e-scale**. The inference to non-uniqueness associated with *a(n)* is then derived as a scalar implicature by standard neo-Gricean reasoning. However, Heim (1991) argued that the uniqueness implication of the definite article is a presupposition rather than an entailment. The non-uniqueness inference associated with the indefinite article would then arise through competition with a lexical item that is presuppositionally stronger, and hence this inference cannot be a regular implicature. Heim proposed that it is derived by the principle of **Maximize Presupposition**, which states that among two sentences with (contextually) equivalent truth conditions the one with the stronger presupposition is to be preferred, provided that these presuppositions are met. This principle explains why, for example, we cannot felicitously utter *A sun is shining*. The speaker should rather utter *The sun is shining*, given that in our solar system there is a single sun and thus the presupposition of *the* is satisfied.

Later work has added to $\langle$*a(n)*, *the*$\rangle$ more instances of presupposition-based scales, or **p-scales**, including $\langle$*all*, *both*$\rangle$, $\langle$PL, SING$\rangle$, $\langle$PRES, PAST$\rangle$, $\langle\emptyset$, *too*$\rangle$, $\langle$*believe*, *know*$\rangle$ (Percus, 2006; Chemla, 2008; Sauerland, 2008; Singh, 2011; Schlenker, 2012). In this paper, I am interested in the p-scale $\langle$*believe*, *know*$\rangle$, where it is assumed that its elements share (contextually) equivalent truth conditions, but *know* adds a presupposition to the effect that its complement is true. Maximize Presupposition then helps us understand why the use of *believe* implies that the presupposition of the *know*-alternative is not certain to hold. Following Percus (2006), I call this type of scalar inference an **antipresupposition**.[7]

(37) a. Actual utterance: John believes it's raining.
  b. Alternative utterance: John knows it's raining.
  c. Antipresupposition: It's not certain that it's raining.

The following lexical entry views *know* as a factive counterpart of *believe*. Below, I add possible worlds to the metalanguage and adopt Heim and Kratzer's (1998) convention of placing presuppositions between the lambda operators and the scope.

(38) $[\![\text{know}]\!]^w = \lambda p \lambda d \lambda x : p(w) \,.\, Cr_{x,w}(p) \geq d$

This entry entails that *know* is gradable, and this is debatable (for discussion, see Partee, 2004; Stanley, 2005). In the face of felicitous examples like *He knows very/quite/full well that I don't like alcohol*, I will tentatively assume that *know* does make available a degree argument, as in (38). Nothing important depends on this choice, though. The above entry can easily be modified to a non-gradable one as follows: $[\![\text{know}]\!]^w = \lambda p \lambda x : p(w) \,.\, Cr_{x,w}(p) = 1$. The above entry also

[6]The way I use the terms "subjective" and "objective" does not quite line up with philosophical parlance on probability. There are several interpretations of probability, including frequentist (probability as chance or proportion) and subjective or Bayesian (probability as a measure of an agent's certainty); see Hájek (2011) for an overview. *Cr* and *Pr* are both "subjective" in the broad sense of being tied to an agent.

[7]To be precise, Percus actually calls antipresupposition what is not taken to hold; in (37), that would be the proposition that it is raining. This use of the term is less common and I will not adopt it here.

entails that *know* is truth-conditionally equivalent to *believe* (for qualifying this to "contextual" equivalence, see Chemla, 2008; Schlenker, 2012).

We can now derive the antipresupposition of *believe* through competition with *know*. I propose to do this by means of a presupposition-based exhaustivity operator that captures the essence of Maximize Presupposition but has the advantage that it may occur in subordinate clauses and generate antipresuppositions locally (cf. *Mike said he believes Kamala will win but he is not sure*).

Let $\langle \alpha_1, ..., \alpha_n \rangle$ be a p-scale and $S(\alpha_i)$ be a Logical Form that contains α_i, an element of this scale. We can define the set of presuppositional alternatives, or **p-alternatives** of $S(\alpha_i)$, as the set of all structurally similar Logical Forms in which α_i may be substituted by one of its scale-mates.

(39) $\textit{p-Alt}(S(\alpha)) = \{\, S(\beta) \mid \alpha \text{ and } \beta \text{ belong to the same p-scale}\}$

Only p-alternatives with a stronger presupposition than the uttered sentence are excludable, i.e., can be denied in order to obtain an enriched meaning. The set of excludable p-alternatives is defined below, where ∂ is a presupposition operator (adapted from Beaver, 2001) that isolates the presupposition of a sentence meaning.

(40) $\textit{p-Excl}(S) = \{\, S' \in \textit{p-Alt}(S) \mid \partial [\![S']\!] \subset \partial [\![S]\!]\}$ (first version)

Work on embedded scalar implicatures has employed a silent exhaustivity operator *Exh* that attaches to a clause and enriches its meaning with the condition that all excludable scalar alternatives are false (Chierchia, 2008, 2013; Fox, 2007; Chierchia et al., 2012). I introduce a presuppositional counterpart *p-Exh*, which adds the condition that the speaker (marked as *s*) is not objectively certain that the presupposition of any stronger p-alternative holds.[8] This essentially means that the speaker lacks appropriate evidence that any such presupposition is true.

(41) $[\![\textit{p-Exh}\ S]\!]^w = [\![S]\!]^w \wedge \forall S' \in \textit{p-Excl}(S) : Pr_{s,w}(\partial [\![S']\!]) < 1$ (first version)

Here is how *p-Exh* derives the antipresupposition associated with *believe*-sentences. The final line below states that John is subjectively certain it is raining but the speaker lacks appropriate evidence for this being the case.

(42) *p-Exh* [John *pos* believes it's raining]
  a. $[\![\text{John } \textit{pos} \text{ believes it's raining}]\!]^w = Cr_{[\![\text{John}]\!],w}([\![\text{rain}]\!]) = 1$
  b. $\textit{p-Alt}(\text{John } \textit{pos} \text{ believes it's raining}) = \left\{ \begin{array}{c} \text{John } \textit{pos} \text{ believes it's raining,} \\ \text{John } \textit{pos} \text{ knows it's raining} \end{array} \right\}$
  c. $\textit{p-Excl}(\text{John } \textit{pos} \text{ believes it's raining}) = \{\text{John } \textit{pos} \text{ knows it's raining}\}$
  d. $[\![\textit{p-Exh} \text{ [John } \textit{pos} \text{ believes it's raining]}]\!]^w$
    $= Cr_{[\![\text{John}]\!],w}([\![\text{rain}]\!]) = 1 \wedge Pr_{s,w}([\![\text{rain}]\!]) < 1$

Chemla (2008) notices that the antipresupposition of *believe* can be invoked to explain the intuition of weakness with first-person belief attributions. Indeed, the structure in (43) derives

[8]The exact way in which the exclusivity component is framed in the literature on antipresupposition varies depending on the modality involved (belief, knowledge, authority), the responsible agent (the speaker or all discourse participants), and the scope of the negation (wide or narrow with respect to the modal operator). The specific choices do not matter to our purposes as long as what is denied is the speaker's objective certainty.

the hedging use by following the same steps as in (42). We get an interpretation according to which the speaker is subjectively certain but is not committed to it being the case that it is raining, presumably because she lacks sufficient evidence to back up her claim.

(43) a. *p-Exh* [I *pos* believe it's raining]
b. $Cr_{s,w}([\![\text{rain}]\!]) = 1 \wedge Pr_{s,w}([\![\text{rain}]\!]) < 1$

The truth condition produced above makes it clear why the hedging use of *x believes that p* is naturally spelled out by a follow-up clause along the lines of *x is not certain that p*. If we agree that *certain* encodes objective probabilities (e.g., $[\![\text{certain}]\!]^w = \lambda p \lambda d \lambda x \,.\, Pr_{x,w}(p) \geq d$), its negation will have the same effect as the exclusivity inference triggered by *p-Exh*.

Our final task is to derive the sensitivity of hedging to the question under discussion. Recall from (24)-(25) that the intuition of weakness arises only when the belief attribution itself is not relevant to the question under discussion. This pattern can be explained if we assume that relevant p-alternatives are filtered out by the computational system. Why should relevant (rather than non-relevant) p-alternatives be excluded by the system? The rationale behind this assumption is that p-alternatives (as the name suggests) are based on presuppositions, and these are typically not relevant.[9] I follow the bulk of the literature in assuming that a proposition is **relevant** to a question if it provides a partial answer to that question, i.e., if it is incompatible with at least one possible answer (Groenendijk and Stokhof, 1984; Roberts, 1996; van Rooy, 2003; Simons et al., 2010).

(44) $\mathbf{rel}(p,Q)$ iff $\exists q \in Q : p \cap q = \emptyset$

We can now restrict the set of p-alternatives that underlies the exhaustivity operator to non-relevant propositions.

(45) $p\text{-}Excl_Q(S) = \{S' \in p\text{-}Alt(S) \mid \partial[\![S']\!] \subset \partial[\![S]\!] \wedge \neg\mathbf{rel}([\![S']\!], Q)\}$ (final version)

Given this refinement, we can understand why weakness arises only if the excludable alternatives are not relevant. This is illustrated schematically by the following two examples. In (46), the *know*-alternative is not relevant to the question under discussion: given that relevance only cares about truth-conditional content, the fact that an agent assigns maximal credence to a proposition does not decide on its truth. Thus, this alternative survives and we correctly predict that a hedging use is available. In (47), by contrast, the *know*-alternative is relevant (it is incompatible with the second question alternative) and does not survive. As a result, exhaustification has no semantic effect and a hedging use is not available.

(46) a. {Is global warming real?} $Q = \{r, \neg r\}$
b. *p-Exh* [I believe global warming is real] $p\text{-}Alt = \{B_s r, K_s r\}$, $p\text{-}Excl_Q = \{K_s r\}$
c. Enriched meaning: $B_s r \wedge \neg K_s r$

[9] This fact lends further support to the claim that the inference to weakness is an antipresupposition rather than a scalar implicature. Scalar implicatures are based on entailment and exhibit the reverse pattern, i.e., they typically arise only if relevant (Romoli, 2013). Compare (i), where the implicature is relevant and difficult to cancel, to (ii), where the implicature is not relevant and very easy to cancel.

(i) Q: Did you read the articles the professor recommended?
A: I read some of them. ?In fact, I read all of them.

(ii) Q: Why did you remove the first slide from your class presentation?
A: Some of the students found it offensive. In fact, all of them did.

(47) a. {Tell us about your environmental beliefs.} $Q = \{B_s r, B_s \neg r, ...\}$
b. *p-Exh* [I believe global warming is real] $p\text{-}Alt = \{B_s r, K_s r\}$, $p\text{-}Excl_Q = \emptyset$
c. Enriched meaning (=basic meaning): $B_s r$

The final version of the semantics for the p-exhaustivity operator is catalogued below.

(48) $[\![p\text{-}Exh\ S]\!]^{c,w} = [\![S]\!]^{c,w} \wedge \forall S' \in p\text{-}Excl_Q(S) : Pr_{s,w}(\partial [\![S']\!]^c) < 1$ (final version)

4. Conclusion

The idea that *believe* expresses universal quantification over possible worlds hails from a long and venerable tradition in formal semantics. This paper challenged this mantra as both too rigid and non-explanatory, pointing out that it does not capture the gradability of *believe* and fails to predict that (an unmodified use of) this verb entails full subjective certainty. I have argued for a semantics that views *believe* as a maximum-degree predicate, allows for its strength to be manipulated by degree modifiers, and correctly predicts that it is closed under conjunction. Importantly, I assumed that the probability measure encoded by *believe* is subjective, which in the right context can give rise to the intuition of weakness. I have shown that this intuition can be construed (and appropriately constrained) as a scalar inference due to the presence of a covert exhaustivity operator that compares alternatives of different presuppositional strength.

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Intonation and Expectation: English Mirative Contours and Particles[1]

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Abstract. This paper proposes a novel account of the English discourse particles *oh* and *huh*. First, these particles are analyzed as being inherently mirative, betraying a speaker's (violated) expectations in a discourse. Second, these particles are systematically paired with idiomatic prosodic contours and contexts to observe how their pragmatic interpretation shifts. Mirativity in English, it turns out, is not limited to particular particles, but can also be a property of prosodic contours. Sag and Lieberman (1975)'s Surprise-Redundancy Contour, is one of them. I propose that understanding the contribution of discourse particle requires intricate pragmatic reasoning strategies which enriches basic meaning of a discourse particle with the pragmatic discourse effects contributed by prosodic variation.

Keywords: discourse particles, prosody, mirativity, expectation, commitment.

1. Introduction

Discourse particles are pragmatic elements that signal a change in a speaker's knowledge state, used to help conversational participants navigate a discourse (Schiffrin, 1987). But this description is incredibly vague. Elements that belong to this class in English can mark acknowledgment (1a), betray a speaker's confusion (1b), or signal a change in topic (1c):

(1) Jeff made pizza dough this morning.
  a. **Oh**. Maybe he'll share some with us.
  b. **Huh**. I thought he didn't know how to cook.
  c. **Well**, I'm making brioche.

I restrict the focus here to two particles: *oh* and *huh*. Here, I ask first what effect these elements have on a larger discourse structure, and second, how much their *performance* impacts interpretation, as in (2):

(2) A: We're all out of flour.
  a. Oh. There's some in the pantry. + *H* L-L%* *Neutral Final Fall*
  b. Oh?! There's some in the pantry! + *(H) L* H* L-L%* *Surprise-Redundancy Fall*

I assume that the interpretation of discourse particles and intonation is pragmatic, and that both track participants' expectations in a discourse context. Such particles are very semantically bleached, and as such, their interpretation is especially sensitive to their prosodic environment. A thorough look at discourse particles must necessarily tease apart the pragmatic contribution of the particle from the interpretation of its prosodic context. With intonational and contextual environments held constant, we can identify places where apparently identical elements pull apart. *Oh* and *huh* appear to serve the same discourse function in (3), but changing the response type, as in (4), shows they are not:

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(3) **A:** The server is down.
  a. **B:** Oh. They must be updating it.
  b. **B:** Huh. They must be updating it.

(4) **A:** The server is down.
  a. **B:** Oh. No it isn't.
  b. **B:** #Huh. No it isn't.

Deconstructing the pragmatic contributions of contours and particles allows us to make predictions about how particles will behave with particular contours, which make testable claims about the additivity of particles' and contours' contributions as speech-act-modifying elements.

2. Defining the Space

2.1. Theoretical Underpinnings: the Table Model of Commitment

Farkas and Bruce (2010)'s Table model of discourse (based on the works of Gunlogson, 2001; Stalnaker, 1978) is a system developed to model commitments, salience, and common ground management. This model decomposes the act of assertion into the effects that it has on a discourse that do not become part of the common ground, and seeks to unify the way in which declaratives and interrogatives are formally represented. Farkas and Bruce (2010) expand the original Stalnakerian model composed of a *Context Set* and a *Common Ground* and propose the addition of a stack of at-issue propositions called the *Table*, sets of *Discourse Commitments* indexed to particular speakers, and a *Projected Set* of future common grounds, accessible from the current contextual state. Assertion is then be defined by the effects that it has on these three elements of the model. The essential components are summarized in (5):

(5)
  a. **Table:** a stack of issues modeling salience in the current context
  b. **Common Ground (*cg*):** the set of all propositions that all members of the conversation are publicly committed to during the course of the conversation
  c. **Discourse Commitments (DCs):** for every participant *x*, the set of propositions that *x* has publicly committed to, but which are not yet part of the CG
  d. **Projected Set (*ps*):** the set of propositions currently under consideration for addition into the *cg*
  e. **Context Set (*cs*):** the set of all worlds that are compatible with the propositions in the Common Ground

Participants in a conversation move forward through a shared commitment to growing the *cg*, and shrinking the *cs*. This is done when speakers raise issues, place them on the Table for consideration, and resolve them by clearing them from the Table. Assertion is modeled by raising an Issue $\{p\}$, which places that issue on the table, which also updates a speaker's *DC*s with p. Farkas and Bruce (2010) define this in terms of a function from an input context K_i, in which an author a asserts a sentence s that denotes a proposition p, to an output context K_o:

(6) $Assert(a, p, K_i) = K_o$ such that: *Based on Farkas and Bruce (2010), p. 92*
  a. $\mathrm{DC}_{a,o} = \mathrm{DC}_{a,i} \cup \{p\}$
  b. $\mathrm{Table}_o = \mathrm{Table}_i + \{p\}$
  c. $ps_o = ps + \{\mathrm{cg}_i + \mathrm{p}\}$

Schematically, this can be visualized in (7), where an initial conversational state (7a) is updated by A's assertion (7b), which places $\{p\}$ on the table and p in A's *DC*s (7c).

(7) **a. Context before utterance:**

$\mathbf{DC}_A$	**Table**	$\mathbf{DC}_B$

$cg : s_0, ps = \{s_0\}$

b. A: asserts p

c. Update context with p**:**

$\mathbf{DC}_A$	**Table**	$\mathbf{DC}_B$
p	$\{p\}$	

$cg : s_0 = s_1, ps = \{\{s_0 \cup p\}\}$

This models the effect of an assertion, which is a a proposal to add the content of an utterance to the *cg*, and a speaker's public commitment to that proposition.

2.2. Expectation

I base much of this work on interpreting a speaker's subjective epistemic bias, which I term 'expectation'. This is influenced by Farkas and Roelofsen (2017)'s work on a speaker's credence level in p. I assume expectation for a proposition is based off of a speaker's (non-categorical) belief calculation for that proposition; expectation is a measure of relative credence levels.[2]

A speaker's expectation for a proposition or event denoted by q is built off her credence level in q, which is conditioned off of various other propositions in the *cs*. If a speaker believes q, we say that her expectation in q is relatively high, calculated against the other propositions in her *cs*. An agent's expectation for some q is based on the joint probability of that proposition and other ps in the *cs*. Expectation is high for q when all ps in the *cs* have a high joint probability with q. In contrast, a low joint probability between q and any context-set p should be enough to lower the expectation in q. This suggests the following definition for speaker expectation:

(8) Expectation for q by a speaker α:
$\text{Exp}_\alpha(q) = \underset{p \in CS}{min}\, P_\alpha(p,q)$

A speaker α *believes* or *expects* q if $\text{Exp}_\alpha(q) \approx 1$. Subjective epistemic bias can be represented as an inequality in expectations for a proposition's truth. $\text{Exp}_\alpha\,(\varphi) > \text{Exp}_\alpha\,(\neg\varphi)$ is a way of talking about a speaker's non-categorical belief in φ, and will prove useful for talking about surprise, which can also be packaged as an instance of a speaker's violated expectations.

2.3. Calculating expectation: Mirative strategies

Many languages have grammaticalized the notion of surprise through particular marking on the verb, on nominals, or as freestanding morphemes, which is known as mirativity. I argue that a miratives are used primarily to communicate a speaker's expectation toward some event. DeLancey (1998); Aikenvald (2012) show through detailed investigation of many languages and language families that mirative strategies overtly map a speaker's surprised reaction toward a proposition to the current state of the common ground. These marked discourse moves add pragmatic information about a speaker's epistemic state to modify literal semantic contributions. The default state of the discourse assumes that there is some baseline range of expec-

[2] I use Expectation as a technical term, which does not necessarily carry the same intuitions as the word *expect*.

tation that most utterances will fall into, and as such, we need not mark violated expectations with every discourse move. Miratives convey that some eventuality falls outside of that normal baseline range; English mirative strategies express these ideas by way of discourse particles and intonation. Consider the difference between (9a) and (9b):

(9) a. Jeff ate the whole tub of yogurt. b. **Wow!** Jeff ate the whole tub of yogurt!

Assuming neutral intonation in (9a), we cannot read much into any pragmatic-level contribution of the speaker. But (9b) conveys an extra pragmatic effect: the speaker is surprised by the content of their utterance. Mirativity marks *how a speaker integrates new knowledge with old knowledge* in a discourse, and how that may affect the expectations she has established.

2.4. Representing Expectation in a Table Model of Commitment

Assertions require speaker commitment to the truth of an utterance. Whereas propositional content that is added to the table is a proposal that must be agreed upon by other discourse participants, the fine-grained pragmatic contributions of an utterance's performance is left out.

Imagine that we have three actors who would like to meet for dessert. Jeff and Tom are waiting for Sophie, and have decided to get ice cream. They notify Sophie and head out. Tom receives a reply from Sophie, informing him that she's lactose intolerant. Prior to this message, both Jeff and Tom assumed this choice was fine for everyone. But when Tom utters (10), the Table model cannot capture the pragmatic calculations that Jeff must compute to make sense of Tom's utterance. When Tom utters (10), he indicates his surprise at receiving this message, while also putting this proposition on the table for Jeff to consider:

(10) **Tom:** Sophie can't go to Mission Hill Creamery! $= p$
Extra inference: *Tom is surprised that p*

The table model as it stands does not have a way to model expectations, which are integral to how actors fit their contributions into a larger context. Intonation works at the speech act level, fine-tuning the exact sincerity contribution an utterance makes. When a speaker uses a neutral falling tone on a declarative, they present themselves as believing the content of that utterance. Doing this means that they must also *expect* this utterance to be true. In (10), Tom's tone is overall falling, but the final fall has a higher pitch excursion than normal, signaling to Jeff that he is asserting this proposition, as well as expressing surprise about it. That surprise is speaker-oriented, and it can't be questioned by the listener; it is infelicitous for Jeff to respond targeting Tom's surprise:

(11) **Jeff:** #You're not surprised about that.

One level of a speaker's *DC*s comes from the act of uttering semantic content, which places a proposition on the table and adds it to their *DC* list. I propose to separate the act of assertion from pragmatic contribution of prosody, logged as illocutionary not-at-issue-content is into the *DC* list. This information is discourse-relevant as commentary that the speaker makes public, but non-negotiable by other players. Using a neutral utterance-final falling tune (H* L-L%) commits the speaker to having a high expectation toward the truth of their utterance:

(12) The neutral H*L-L% contour adds the following to the speaker's DC:
$\text{Exp}_{spkr}(p) \approx 1$

Adding expectational content from intonation to the *DC* list allows us to easily model the pragmatic effect of intonation and discourse particles.

3. Contours and Particles

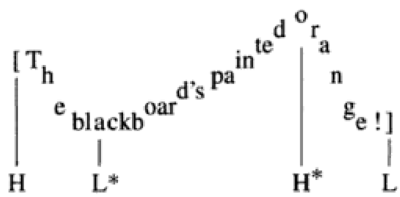
This work seeks to explain the effects of three English mirative strategies: the SRC, *oh*, and *huh*. Though superficially different, these markers have the following four things in common:

(13) a. *Optionality*: never semantically necessary, only contribute pragmatic content
b. *Illocutionary not-at-issueness*: updates are to a speaker's expectational state
c. *Speech act modifiers*: comment on elements above the propositional level
d. *Contextual dependence*: use is interpretable only in context

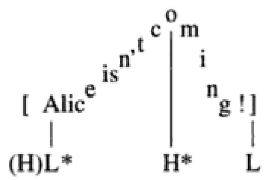
I argue that these elements are inherently mirative, commenting on a speaker's (violated) expectations in context. The following sections propose that interpretations of the Surprise-Redundancy Contour, the particle *oh* and the particle *huh* can be analyzed along similar grounds.

3.1. Surprise-Redundancy Contour

Sag and Lieberman (1975) identify the surprise-redundancy contour (SRC) as an utterance-level prosodic tune that carries pragmatic information about speaker attitude. Their classification assumes that the contour is an intonational idiom consisting of a high pitch anchored to the primary sentential accent, and contrasting low pitch on the utterance's second most prominent syllable left of the main stress placement, as in (14) (Hayes, 1995; Ladd, 2008):

(14) a. 

The blackboard's painted orange!↘

b. 

Alice isn't coming!↘

Sag and Lieberman (1975) identify this contour as expressing a speaker's surprise at a proposition or event in the world, much as a speaker might do in (14a) upon walking into a classroom with a brightly painted chalkboard, or in (14b) when, exasperated, they must repeat something they believes the hearer "should have known". If it is established that Alice is currently vacationing in Bermuda, asking why she isn't around is redundant. Using the SRC in 'redundancy' cases is akin to overtly questioning your addressee's information state. For a detailed look at the differences between 'surprise' and 'redundancy' readings of the SRC, see Kraus (2018).

Though it requires two stressed tones, the SRC can also appear on prosodic phrases with a single prominent position, or even a single syllable. To do this, the vowel is lengthened, giving the effect of two syllables:

(15) a. Mother: Did you brush your teeth?
Child: Du- uh!
L* H*-L%

b. Mother: Don't forget to floss!
Child: Mo- om!
L* H*-L%

A speaker uses the SRC to point to something about the a participant's actions or utterances in previous discourse that they are not currently taking into account. With the SRC, a speaker highlights an issue that she believes is inferable, but is being ignored. I formalize this in (16):

(16) The English Surprise Redundancy Contour (H) L* H*-L% is anaphoric to a salient proposition or event p in a discourse context C, and is admissible for discourse-salient participants x when

a. q is the proposition expressed by the speaker (uttered content or the presuppositions introduced by a question),
b. add the following to the speaker's *DC*s:
$\mathrm{Exp}_{spkr}(q) \approx 1 \wedge \forall x \in C\ [\mathrm{Exp}_x(p|q) \approx 0]$

I discuss the pragmatic contribution of the SRC more fully in Section §4.2.

3.2. English *oh*

Abstractly, *oh* marks some change of state that has occurred, whether in the speaker's reasoning or in their accessible information (Aijmer, 2002). (17) shows this particle used similarly to a response particle, whereas (18) is closer to a discourse particle use:

(17) *Speaker walks into a room full of snakes:*
Oh!

(18) *Speaker receives news that the room full of snakes is to be incinerated:*
Oh! That's great news!

Surprise can be captured in terms of violated expectations, marking a change in a speaker's reasoning from a previous state. Other emotions can also be thought of in terms of a change of state. Anger, for example, can be framed as a negative change in speaker expectations. When using *oh*, a speaker indicates both her own change of state, as well as primes the listener for an upcoming change to their own discourse model (Fox Tree and Schrock, 1999).

Gunlogson (2008) notes that *oh* can be used to diagnose speaker commitment when paired with a neutral fall(H* L-L%). A neutral *oh* response to a previous utterance has a similar effect to the response particle *yes*, committing the speaker to the content of the previous proposition. But unlike *yes*, *oh* signals that this is new information to the speaker:

(19) A: They quarantined that room.

a. B: Yes. *commits to A, A can already be known to B*
b. B: Oh. *commits to A, A is not already known to B*

In both cases, the particles commit the speaker to the content of A's utterance. Yet while *Yes* with rising intonation commits the speaker to the content of A's utterance, the same rise on *oh* does not commit B to A's utterance (for an in-depth discussion of the varied contributions of types of rising intonation, see Jeong, 2017):

(20) A: They quarantined that room.

a. B: Yes? *B is committed to content of A*

b. B: Oh? *B is* ***not*** *committed to content of A*

Oh's contribution cannot be commitment. This is clear in out-of-the-blue cases, where a speaker reacts to some environmental factor, rather than a previous utterance:

(21) *Speaker walks past a charred building:*
a. Oh! b. Oh! They burned the snakes!

Oh with excited intonation highlights a speaker's surprise about an event. While a follow-up utterance may provide some proposition to commit to, the particle in itself does not. (21a) simply conveys a speaker's violated expectations. In keeping with 'change-of-state' as a core meaning component of *oh*, I propose that the particle requires an inequality between a speaker's expectations and the information that they have been presented with, allowing the hearer to infer that something did not accord with how the speaker imagined the conversation would progress:

(22) *oh* is anaphoric to a proposition p salient in the discourse s.t.:

a. $oh(p)$ adds the following to the speaker's *DC*s:
$\text{Exp}_{spkr}(p) < \text{Exp}_{spkr}(\neg p)$

Oh indicates that the speaker had higher expectations for $\neg p$ over p. Expectation allows the contribution of *oh* to operate on a pragmatic level, commenting on a speaker's view with immunity to public scrutiny as shown in (23):

(23) A: The University has banned reptile rooms.
B: Oh.
A: #That's not true. You expected that.

Formulating the contribution of *oh* in terms of expectations casts this particle as a mirative marker. Mirativity relies on the reinterpretation of a speaker's expectations. With excited intonation, the mirative strategies have an additive effect. In an utterance like (21), the speaker can augment her degree of surprise by using an excited contour. We will come back to this point, as the interaction of particles and intonation will be crucial to understanding their overall discourse function.

3.3. English *huh*

In many cases, *huh* patterns alongside *oh*, leading many to assume them to be interchangeable. Indeed, it is also a particle that indicates a shift in speaker expectations:

(24) *Speaker receives news that the room full of snakes is to be incinerated:*
a. Huh! b. Huh! That's great news!

But in particular cases, *huh* patterns differently than *oh*. One place is in cases where two participants have equal information. In (25a), B can use *oh*, although she overtly indicates that she is already aware of the content of A's utterance, but she can not indicate this with *huh*.

(25) They quarantined that room.

a. B: Oh. I know. b. B: #Huh. I know.

Huh's behavior also patterns differently in the Gunlogsonian test for commitment to a previous utterance. B can utter (26a) without going to check on the status of the room in question. But uttering (26b) is odd if B has not gotten up, and verified A's assertion:

(26) A: That room is full of snakes.

a. Oh. No it isn't. (It just looks like that.)

b. #Huh. No it isn't.

In (26b), the particle and the continuation utterance are two unconnected conversational moves, whereas (26a) serves as a reaction and an explanation for the reaction. It appears that *huh* must acknowledge and at least temporarily accept the previous proposition. I propose a formulation of *huh*'s discourse contribution in much the same way as *oh*. *Huh* also requires a contextual inequality between a speaker's expectations and the information that she is faced with, as well as a further restriction.

(27) *huh*(p) adds the following to the speaker's *DC*s:
$\text{Exp}_{spkr}(p) < \text{Exp}_{spkr}(\neg p) \wedge \text{Exp}_{spkr}(p) > 0$

Huh requires that the speaker have expected $\neg p$ over p while also commenting on the speaker's relative expectations about p. This is clear with contextual differences in cases of speaker surprise. With an excited contour, out-of-the-blue scenarios of surprise are bad with *huh*:

(28) *Speaker, oblivious, rounds the corner and is hit with confetti:*

a. Oh! I didn't expect that! b. #Huh! I didn't expect that!

But if a surprise is expected, for example, in the case that the speaker and her colleagues occasionally play practical jokes, both *oh* and *huh* are available:

(29) *Speaker, an occasional practical joker, rounds the corner and is hit with confetti:*

a. Oh!/Huh! I didn't expect that!

Again, formulating *huh*'s contribution in terms of violated expectations has the advantage of comparing this particle to other markers of mirativity.

4. Compositionality: the relation of text to tune

Previous accounts of English discourse particles show that these elements are impressively flexible, but no research to date looks at the compositionality of discourse particle meaning and intonational meaning. In an effort to sharpen the picture even further, I outline a number of contexts that turn out to have an interesting effect on a particle performance's felicity. By pinpointing specific discourse contexts and holding them constant, we can see what other kinds of extra-linguistic factors these pragmatic markers are sensitive to. The felicity of these particles is not limited to their combinability with particular contours; they interact with the overall structure of the discourse, too. Due to space restrictions, I present a subset of relevant discourse contexts here to show this difference. For a fuller picture, see Chapters 3 & 4 of Kraus (2018), which lays out a more in-depth theoretical argument backed up by experimental evidence.

Below is an overview of four of the relevant contexts and manipulations, and the behavior of *oh* and *huh* with each context + prosody pair:

	Neutral Fall H* L-L%		**SRC Fall (H) L* H* L-L%**	
Context	*oh*	*huh*	*oh*	*huh*
Eavesdropping	✓	✓	✓	✓
Sudden Realization	✓	✓	*	✓
Contradict a Statement	✓	*	*	✓
Correct a fact	✓	*	✓	✓
Accept a fact	*	*	✓	✓

Table 1: Contours, contexts, and particle combinations

In broad strokes, when paired with the neutral falling contour, *huh* is licensed in a proper subset of the environments that license *oh*. This generalization is reversed when *oh* and *huh* appear with the SRC. In all these cases, the additive properties of a particle's pragmatic contribution and a contour's contribution can derive the patterns seen in the table above. The following two sections break this down and show just how we can use speaker expectation to understand how these patterns emerge in each discourse context.

4.1. Text and Tunes: Neutral Falling H*L%, *oh*, and *huh*

Recall that *oh* and *huh* differ only in the expectations that are placed a speaker's *DC* list:

(30) *oh* and *huh* are anaphoric to a proposition p salient in the discourse s.t.:

a. *oh*(p) adds the following to the speaker's *DC*s:
$\text{Exp}_{spkr}(p) < \text{Exp}_{spkr}(\neg p)$

b. *huh*(p) adds the following to the speaker's *DC*s:
$\text{Exp}_{spkr}(p) < \text{Exp}_{spkr}(\neg p) \wedge \text{Exp}_{spkr}(p) > 0$

The difference between the two is the extra pragmatic effect that *huh* expresses. In contrast to *oh*, when using *huh*, the speaker conveys that she did not entirely rule out the situation that she currently finds herself in. In what I assume is the base case, neutral, falling contours on discourse particles have the effect of an assertion—a property of an intonational contour, not of a particular sentence form. I assume that neutral, falling contours assert the content of the proposition they take as their prejacent. I follow Farkas and Roelofsen (2017) and Malamud and Stephenson (2015) in assuming that a falling declarative asserts speaker belief in p, which I formulate in terms of expectation contributed by the contour:

(31) The neutral falling H*L-L% adds the following to the speaker's *DC*s:
$\text{Exp}_{spkr}(\text{p}) \approx 1$

For the most part, *oh* and *huh* pattern in very similar ways, and are available in overlapping contexts. Both can be used with the neutral contour to indicate sudden realization (32) and eavesdropping situations (33), and are both disallowed in cases of fact acceptance, as in (34):

(32) *Speaker walks out of a building, with no expectation of the weather.*
Oh./Huh. It's raining. *Sudden Realization*

(33) *Characters are speaking to other characters in a film.* A: It's Tess Ocean!
B, *also observing the film:* Oh./Huh. It's clearly Julia Roberts. *Eavesdropping*

(34) A, (*Quizmaster*): What's the capital of Delaware?
B: Dover.
A: It is Dover.
B: #Oh./#Huh. I was right. *Accept a fact*

Oh and *huh* do pull apart when contextual assumptions shift. The Gunlogsonian test for commitment with the neutral falling contour works with *huh* in cases where B has less evidence or a lower expectation than A (35). But when a speaker has equal to or higher expectation for the truth of a proposition, *huh* is no longer a licit response, and is also no longer a diagnostic for commitment (36):

(35) A: The server's down.
a. B: Oh. (I didn't know that.)
b. B: Huh. (I didn't know that.)

(36) A: The server's down.
a. B: Oh. I know.
b. B: # Huh. I know.

If B uses *huh* in (36), they set up an inconsistent set of *DC*s for them to go on to inform A that this issue is already known. *Huh* reacts to the speech event here: B is surprised to be informed of something is believed to be common ground. Using *huh* communicates she is communicating the following things about her doxastic state:

(37) B: # Huh. I know.
a. B did not expect A to assert p, "The server is down" $[\text{Exp}_A(p) < \text{Exp}_A(\neg p)]$
b. B holds a non-zero expectation for the possibility that A will make the speech event "The server is down."

While this is a consistent belief state, it is contradictory to convey this to an addressee. When surprise is directed at the level of illocution, *huh* is a strange pragmatic choice. This seems to be a special case of fact contradiction contexts, as in (36), repeated in (38) where a speaker attempts to use *huh* in an instance where they mean to directly contradict the previous statement:

(38) A: That room is full of snakes.
a. B: Oh. No it isn't. (It just looks like that). b. B: # Huh. No it isn't.

This fact is borne out in the formulations of these particles where *huh* has an added restriction that there must be some expectation already calculated to a given surprising proposition.

This predicts that *oh* is more permissive than *huh*, particularly in cases of extreme surprise or with events where the speaker may have had zero expectation for p. For *huh*, while the context does favor expectation for $\neg p$ over p, it still requires p to be an available option for the speaker's chain of reasoning.

Both particles are mirative marking strategies, which rely on the expectations of the speaker. In most of the contexts discussed so far, the surprising element is an issue raised and placed on the table by an interlocutor. But as we have just seen, out of the blue cases of surprise, as well as some correction cases, target a larger event. This ability to target illocutionary content is part of the mirative function of these particles, coupled with pragmatically introducing a speaker's own subjective bias. Placing a speaker's expectational commitments in a table model of discourse is a convenient way of keeping track of issues raised, common ground material, and conversational participants' subjective epistemic states. For particle only responses like (35), a speaker's discourse commitments are updated as in (39):

(39) A: The server is down. B: Huh.

a. Context after A's utterance:

DC$_A$	**Table**	**DC$_B$**
p, Exp$_A$ $(p) \approx 1$	$\{p\}$	

$cg : s_0,\ ps = \{\{s_0 \cup p\}\}$

b. B utters *huh*

c. Context after B utters *huh*:

DC$_A$	**Table**	**DC$_B$**
p, Exp$_A$ $(p) \approx 1$	$\{p\}$	Exp$_B(p) <$ Exp$_B(\neg p)$ $\wedge$ Exp$_B(p) > 0$

$cg : s_0,\ ps = \{\{s_0 \cup p\}\}$

With no clear commitment one way or another, the speaker and hearer may choose to take this particle response as committing B to p, thus clearing the scoreboard. This reasoning is due in part to the contribution of the final fall. In (39), a neutral falling contour on the particle allows A to infer that B has accepted this contribution. This can then grow the common ground. When B responds with the particle and a following utterance, the expectations that follow are logged in their *DC*s, and the propositional content of p is placed on the Table. Pragmatic reasoning takes the entire utterance and performance into account to determine whether B's contribution was an accepting or rejecting move.

I modify the Table model to include the stack of propositions on the table that have yet to be accepted or rejected. In (40), neither p nor q has been explicitly accepted by both participants. For the sake of simplicity, I assume that only the most recent proposition in the stack, q is represented in the projected set, though there may be other approaches to representing this state of a discourse.

(40) A: The bank is closed today. = p
B: Oh. I need to deposit a check. = q

a. Context after A's utterance:

DC_A	Table	DC_B
p, $\mathrm{Exp}_A\ (p) \approx 1$	$\{p\}$	

$cg : s_0,\ ps = \{\{s_0 \cup p\}\}$

b. B utters *oh* + q

c. Context after B utters *oh*+q:

DC_A	Table	DC_B
p, $\mathrm{Exp}_A(p) \approx 1$	{q} {p}	q, $\mathrm{Exp}_B(q) \approx 1$, $\mathrm{Exp}_B(p) < \mathrm{Exp}_B(\neg p)$

$cg : s_0 = s_1,\ ps = \{\{s_0 \cup q\}\}$

B's utterance here is not a clearly accepting or rejecting move. As *oh* does not supply this confirmation, and B's following utterance leaves the option open, both *p* and *q* are issues up for discussion. We reason that the falling contour on both *oh* and *q* lead A to infer that *p* is resolved, and cleared from the table. I assume that the individual discourse commitments of a particular speaker are related by conjunction. Pragmatic meanings contributed by particles and contours are calculated additively by the expressions in a participant's discourse commitments.

This distinction between non-zero and no expectation that drives the differences between *oh* and *huh* can explain the oddness introduced by fact correction scenarios, as in (41):

(41) A: Sandy is from Nebraska.

a. B: Oh. She's from California.
   H* L-L%   H* L-L%

b. B: # Huh. She's from California.

In both (38) and (41), B disagrees with A's proffered content, in the former, by offering explicit contradiction, and the latter, by offering up conflicting information that B knows. In both of these scenarios, *oh* is allowable, while *huh* is not. Knowing a fact *q* about the world implies high expectation for it to be true: $\mathrm{Exp}_{spkr}(q) \approx 1$. If someone utters *p*, a fact that would make *q* false, a speaker can signal this discrepancy with *oh*; based on their belief in *q*, they have no reason to believe *p* to be true. If B knows that Sandy is from California, he has reason to believe that she is not from other places. With this information in B's discourse commitments, but not actively on the Table, the listener can infer the following:

(42) *Sandy is from Nebraska* = *p* *Sandy is from California* = *q*

a. Context after A's utterance:

DC_A	Table	DC_B
p, $\mathrm{Exp}_A(p) \approx 1$	$\{p\}$	

$cg : s_0,\ ps = \{\{s_0 \cup p\}\}$

b. B utters *huh* + q

c. Context after B utters *huh* + q:

DC_A	Table	DC_B
p, $\mathrm{Exp}_A(p) \approx 1$	{q} {p}	q, $\mathrm{Exp}_B(q) \approx 1$, $[\mathrm{Exp}_B(p) <$ $\mathrm{Exp}_B(\neg p) \wedge \mathrm{Exp}_B(p) > 0]$

$cg : s_0 = s_1,\ ps = \{\{s_0 \cup q\}\}$

Pragmatic calculation:

i. **Falling contour:** $\mathrm{Exp}_B(q) \approx 1$

ii. ***huh*:** $\mathrm{Exp}_B(p) < \mathrm{Exp}_B(\neg p) \wedge \mathrm{Exp}_B(p) > 0$

iii. **Pragmatic inconsistency:** $q \rightarrow \neg p$, so $\neg p$ = 1. Since q and p are contrary, one cannot commit to q being true and to p being possible.

Huh's added restriction that the expectation for *p* be non-zero leads to an inconsistent pragmatic calculation. If B knows his information is correct, there is no way that he can felicitously signal that with *huh*. But he can with *oh*:

(43) *Sandy is from Nebraska* = p *Sandy is from California* = q

a. **Falling contour:** $\text{Exp}_B(\text{q}) \approx 1$

b. ***oh*:** $\text{Exp}_B(p) < \text{Exp}_B(\neg p)$

c. **Pragmatic consistency:** $q \to \neg p$, so $\neg p = 1$. B must have expected p to be 0.

Notice how *huh* again becomes licit when B's uncertainty is put back into play:

(44) A: Sandy is from Nebraska.

a. B: Oh./Huh. I thought she was from California.

When B indicates overtly that they are not sure about the contribution, *huh* again becomes licit. The semantic content of this utterance allows for felicitous pragmatic interpretation of *huh*.

4.2. Text and Tunes: Surprise-Redundancy, *oh*, *huh* and *what*

The previous sections showed the overlap in meaning between *oh* and *huh* in the pragmatic context of a neutral final fall. In this section, the pragmatic effects of the SRC show a different split between the conditions of use of *huh* and *oh*.

Recall that SRC is more complex than other final falls, requiring at least a rise-fall pattern with two different prominent tone heights, (H) L* H* L-L%. The pragmatic effect of the SRC is complex as well–it indicates that the speaker believes the listener "should have known" some salient proposition in the discourse. This contour bakes in a mirative meaning itself, anchoring itself to speaker expectations about some participant in the discourse. Formally, I represent the pragmatic contribution of the SRC to the discourse in (45), repeated from (16):

(45) The SRC (H) L* H*-L% is anaphoric to a salient proposition or event p in a discourse context C, and is admissible for discourse-salient participants x when:

a. q is the proposition expressed by the speaker (uttered content or the presuppositions introduced by a question),

b. add the following to the speaker's *DC*s:
$\text{Exp}_{spkr}(q) \approx 1 \wedge \forall x \in C\ [\text{Exp}_x(p|q) \approx 0]$

This formalization does not presume to break down the prosodic components of the SRC into meaningful sub-phrasal tones. Rather, it assigns a conventional pragmatic effect to this prosodic phrase-level melody. The SRC anchors speaker expectation to a proposition q, while expressing the speaker's secondary expectation that given q, everyone in the discourse context should have very low, if not zero expectation for p. In other words, the speaker expresses surprise that the conversational participants have deduced p, given what she expects them to have predicted by having access to q. The speaker does not expect p, and assumes no one else should either.

A small note on the notation used here to show the relationship between p and q is in order. The formulation $\text{Exp}_x(p|q) \approx 0$ could either refer to conditional probability or likelihood ratios. This should be understood in the likelihood function use as we are not making predictions about some future outcome or state of the discourse, which expectation calculations based on conditional probabilities would assume. Because this contour is used in response to an unexpected or surprising event, the speaker is using this contour in the face of specific, observed data. We want to express that given the situational facts and observations, the computed likelihood for some at-issue proposition is quite low.[3]

Just like other miratives, using the SRC is a strategy that publicizes the speaker's current epistemic state. By placing its contributions in a speaker's *DC*s, a speaker signals to the listener that this is not at-issue content, but that it is content that the speaker is committed to:

(46) A, *(with SRC:)* This cheddar cheese is orange!↘
B: # That's not true. You aren't surprised at all.

The SRC can combine with both discourse particles of interest. So as not to confuse this contour with a rising declarative, in the examples below, I use a question mark followed by a fall '?↘' to represent an intended instance of the SRC. The following contexts show where *oh* and *huh* pattern the same with the SRC:

(47) *Character speaking to other characters in a film* A: It's Tess Ocean! *Eavesdropping*
a. B, *Moviegoer, observing the film:*
Oh?↘/Huh?↘ It's clearly Julia Roberts?↘

(48) A, *Quizmaster:* What's the capital of Delaware? *Fact Acceptance*
B: Dover.
A: It is Dover.
a. B: Oh?↘/Huh?↘ I was right!

Both particles interacts with the SRC in a subtly different way. With *oh*, there is a pragmatic inference that the addressee's utterance is very speaker-new. The speaker is taken off guard; they have not previously entertained the proposition in question. This nicely falls out from *oh*'s characterization in (30a), as no imposed floor on a speaker's expectation for a preceding utterance allows for a genuine violation of expectations.

Like *oh*, *huh* also express heightened levels of disbelief when paired with the SRC. Another contribution of this contour comes at the perlocutionary level: the contour not only expresses

[3] I choose to use likelihood ratios for a few reasons. One salient reason is that when using simple probability, average propositions and their negations will not have roughly equal probability. This is based off the observation that for a proposition p to hold, all of its entailments must also hold. But for $\neg p$ to hold, just one of p's entailments can be false. Given this, it will tend to be the case that out of p and $\neg p$, one of these will have an intrinsically higher base probability. But though this is valid, this fact should not have an impact on the calculation of surprise.

If we think about surprise in terms of joint, conditional, or even just raw probability, we miss the relevant idea of surprise, as we cannot relativize this to a particular context. We want to get rid of the idea that surprise can be calculated context-free, which is what we would predict if we used any of the measures above. Using a likelihood ratio of the joint probability of the antecedent and the at-issue proposition, normalized against the probability of the antecedent and the at-issue proposition ($\frac{P(p,q)}{P(p)\times P(q)}$), we no longer have a sensitivity to the number of entailments that are carried either by the antecedent (p) or the at-issue proposition (q). Likelihood ratios are a way of achieving the normalization that is needed for context sensitivity by unlinking violated expectations from raw probability.

a speaker's expectations, but also persuades the addressee to react. This contour is inherently a request for the addressee to bolster their claims before the speaker will commit to their discourse move. This effect is strong—so strong that it is strange for a discourse to end with an utterance that carries the SRC. The pressure is high for the addressee to respond, likely due to *huh* explicitly encoding that an alternate proposition is more likely.

The prosodic environment imposed by the SRC flips some of the patterns of grammaticality between *oh* and *huh*. Whereas composing *huh* with either the neutral or the excited contours revealed that this particle occurred in a subset of the contexts where *oh* could occur, the findings are switched with the SRC. *Oh* becomes the particle with the more limited distribution, which is a subset of the contexts in which *huh* can appear. One place where the particles behave differently is in fact correction and contradiction contexts. Recall that *huh* is disallowed in both of these contexts when paired with a neutral H* L-L% contour:

(49) A: Sandy is from Nebraska. *Fact Correction*
   a. B: Oh?↘ She's from California?↘   b. B: Huh?↘ She's from California?↘

(50) A: That room is full of snakes. *Contradiction*
   a. B: #/? Oh?↘ No it isn't?↘   b. B: Huh?↘ No it isn't?↘

One first thing to observe is that none of the B responses completely settle the issue at hand. Rather, they invite A to weigh in on the matter again, whether it be to provide counter-evidence, or to commit to the proffered alternative. This is a pragmatic effect from the SRC, calculated when the speaker projects their own relatively high expectations about the prejacent and the expectations generated about other participants' beliefs about the alternative. The SRC must comment on something mutually manifest. In the case that the speaker offers an alternative to *p* that their conversational participant *couldn't have been aware of*, the result is an incoherent discourse state, regardless of the particle used:

(51) *Sophie and Tom are supposed to pick Jeff up from the airport at 2pm. Tom, but not Sophie, receives a flight alert, telling him that Jeff will be delayed until 4pm. Later, they are talking about when the need to leave to pick Jeff up*:
   Sophie: I can be ready to leave for the airport at 1:30pm.
   Tom: # Oh?↘/Huh?↘ His flight doesn't come in until 4?↘

Though the intuition is not as sharp as in other cases, the felicity of *oh* is questionable in cases of direct contradiction. Recall though, the difference between *oh* and *huh* in neutral contexts. There, *huh* was illicit, but in an interesting way. It necessitated extra accommodation on the part of the speaker in order for it to be interpretable; *huh* responses in those cases constituted two conversational moves: a discourse particle response, an intermediate verification step, and then a second corrective conversational update. A similar thing happens with SRC *oh* responses to contradiction environments. (50a) is only licit if *oh* is one discourse move, followed by a verification, and a corrective follow-up utterance.

Oh is infelicitous here due to the SRC's discourse management strategy that allows a speaker to assert an alternative proposition while implicitly requesting the addressee's feedback on it.

The alternative that the speaker offers must be an alternative that the listener could arrive at by carefully considering the *cg* and the *ps*. *Huh* is no problem because its meaning bakes in a non-zero chance that an alternative explanation is available. Cases of contradiction or fact correction are not purely contradiction because the mirative component of *huh* assumes that however unlikely *p* may be in the speaker's estimation, it is still a viable alternative.

But *oh* has no requirement that the speaker's expectation of the prejacent be greater than 0. *Oh*'s freedom is a weak restriction: because there are alternative particles that require uncertainty about a proposition, using a particle that does not have this requirement confronts the listener with a potential Maxim of Quantity violation. The speaker uses this because they want to indicate that they expect *p* to be 0 (from 50):

(52) *This room is full of snakes = p* *The is room is not full of snakes = q*

a. Context after A's utterance:

$\mathbf{DC}_A$	**Table**	$\mathbf{DC}_B$
p, $\text{Exp}_A(p) \approx 1$	$\{p\}$	

$cg : s_0$, $ps = \{\{s_0 \cup p\}\}$

b. B utters *oh* + *q*

c. Context after B utters *oh* + *q*:

$\mathbf{DC}_A$	**Table**	$\mathbf{DC}_B$
p, $\text{Exp}_A(p) \approx 1$	$\frac{\{\text{q}\}}{\{\text{p}\}}$	q, $[\text{Exp}_B(p) < \text{Exp}_B(\neg p)$ $\wedge$ $\text{Exp}_B(p) > 0]$, $[\text{Exp}_{A,B}(p\vert q) \approx 0]$

$cg : s_0 = s_1$, $ps = \{\{s_0 \cup q\}\}$

Pragmatic calculation:

i. **SRC:** $\text{Exp}_B(q) \approx 1 \wedge \forall x \in DC\ [\text{Exp}_{A,B}(p|q) \approx 0]$

ii. ***oh*:** $\text{Exp}_B(p) < \text{Exp}_B(\neg p)$

iii. **Pragmatic consistency (?):** $q \rightarrow \neg p$. Speaker believes q = 1, infer $\neg p$ = 1. There is no restriction that p be 0.
BUT: Pragmatic competition w/ *huh* can leads one to wonder why *oh* was used.

If the speaker wants to directly contradict *p*, then they must have evidence against *p*. But the SRC still allows for the possibility that the speaker's expectations might be violated, which sets up a (defeasible) inconsistency: a speaker can fully expect *p* to be false (from *oh*) but when they do this, they cannot also expect it to be *almost always* be false (from the SRC). This appears to be a by-speaker pragmatic calculation in need of empirical validation. While some argue that *oh* with the SRC in contradiction cases is pragmatically fine, the same individuals agree that there is a cline of acceptability in the following responses to the same utterance, with direct contradiction cases more pragmatically odd:

(53) A: Sandy is from Nebraska.

a. B: ??Oh?↘ No she isn't! She's from California!↘

b. B: ?Oh?!↘ She's from California!↘

c. B: Oh?!↘ She has a California driver's license?!↘

With *huh*, the listener accommodates that they are not being directly contradicted: the speaker's expectation for *p* was greater than zero, leaving room that expectation of *q*, however strong, is not certain. Though the SRC signals to the listener that by the speaker's estimation, they should have known an alternative proposition *q*, it invites further commentary from the listener by leaving the door open for follow-up. A more robust pattern of acceptability emerges from cases of sudden realization:

(54) *Speaker walks out from a windowless building, having no expectation for it to be raining:*
a. #Oh?!↘ It's raining?!↘ b. Huh?!↘ It' raining?!↘

If a speaker is talking to herself, (54a) is odd. But when sudden realization cases involve another participant, *oh* gets better:

(55) *A and B are solving math problems. A turns to write one on the board and picks up the chalk in her left hand*:
B: Oh?!↘ You're left-handed?!↘

If a speaker is addressing herself, a Quantity implicature arises from the interaction of the SRC, the requirements of *oh*, and the fact that the speaker did not use a rising declarative, indicating that they can not commit to p. The listener assumes that the speaker must have had some reason for using *oh* when *huh* was available as well. They deduce that the speaker expects q to be true:

(56) *The fact that it's raining = p* *It is raining = q*
Context after B utters *oh* + q:

$\mathbf{DC}_A$	**Table**
q, $[\mathrm{Exp}_A(q) \approx 1$	{q}
$\wedge\ \mathrm{Exp}_{A,B}(p\|q) \approx 0]$	{p}

$cg = \emptyset$, $ps = \{\{p\},\{q\}\}$

Pragmatic Calculation:
i. **SRC:** $\mathrm{Exp}_B(q) \approx 1 \wedge \mathrm{Exp}_B(p|q) \approx 0$
ii. ***oh*:** $\mathrm{Exp}_B(p) < \mathrm{Exp}_B(\neg p)$
iii. **Pragmatic inconsistency:** $q = \neg p$. Speaker believes $q = 1$, infer $\neg p = 1$.
There is no restriction that p be 0.
The speaker is both the addressee and the source of q; they hold one belief about the actual facts in the world, p, and another about their expectations, $q = \neg p$.

When p turns out to be true, the free variable in the definition of the SRC allows for the speaker to believe $q \approx 1$, while also strongly expecting that p is not the case. But the speaker has also just observed that it is raining. Using a rising declarative has the pragmatic discourse effect of indicating the speaker cannot commit to p, the highlighted alternative. But facts about the world prove otherwise. The speaker has seen the rain, and knows p is true. Her internal state is in conflict: she cannot know for sure that it's raining (p=1), expect that it's not ($q = \neg p$=1), and expect that given q, the expectation for p should be 0. In this case, there appears to be such a thing as too much mirativity.

5. Conclusion

This paper serves as both an argument recognizing that English has active mirative strategies, as well as a petition for an updated look at how the contribution of discourse particles and prosodic meaning can shape a conversation. Discourse particles contribute information about how a speaker has structured her expectations, and how those expectations have come to be met or violated. Intonation plays an extremely similar role. While some utterance-level contours contribute straightforward pragmatic effects of authoritativeness or excitement on the part of the speaker, others are more nuanced. Viewing these contours in terms of a speaker's expectations about a discourse has the advantage of pinpointing which contours convey authoritativeness by virtue of assigning the truth of a proposition a high expected value. It can also capture the effects of contours that express violated expectations in view of a discourse context. By reshaping the way we view intonation and discourse marker meaning, we create a common foundation for analyzing these two distinct systems. Doing this gives us a coherent way forward in interpreting the many ways a speaker sheds light on her internal belief structure. This in turn provides a glimpse of the conversational structure, and a way to talk about the interactions between the text of a sentence and its tune.

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Stating the obvious: *Of course* as a focus-sensitive marker of uncontroversiality[1]

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Abstract. The English discourse particle *of course*, part of a cross-linguistic class of elements that express the 'uncontroversiality' of a proposition, has received little attention from theoretical linguists. Studies in the domain of uncontroversiality, particularly of the German particles *doch* and *ja*, typically treat uncontroversiality as a property that holds of a proposition for all participants in a discourse. We first show that *of course* cannot be folded into prior treatments of *doch* and *ja*. Furthermore, we argue that *of course* motivates a finer-grained notion of uncontroversiality that is focus-sensitive and relativized to individual discourse participants. While our analysis in principle allows for relativizing uncontroversiality to multiple discourse participants, we argue that *of course* is semantically relativized only to the speaker. Rather than being lexically specified, we argue that the apparent addressee-oriented uncontroversiality conveyed by *of course* follows from general pragmatic reasoning about shared knowledge in a discourse.

Keywords: discourse particle, polarity, uncontroversiality, pragmatics.

1. Introduction

The semantic and pragmatic contributions of the English discourse particle *of course* have been underexplored in the theoretical linguistics literature (though see Holmes 1988 for a functionalist view). A canonical example of *of course* in discourse is given in (1).[2]

(1) A: Did Maude make her famous kumquat strudel for the potluck?
B: **Of course** she did(n't).

B in (1) both provides an answer to A's question and, informally, conveys that the answer is or should be obvious to A, i.e., that the answer is *uncontroversial*.

Particles that have been argued to communicate uncontroversiality are found cross-linguistically in, e.g., German *doch* and *ja* (Grosz, 2010; Kaufmann and Kaufmann, 2012; Kraus, 2018: a.o.), St'át'imcets *qa7* (Kratzer and Matthewson, 2009), Finnish/Estonian *kyllä/küll* (Keevallik and Hakulinen, 2018), and Tagalog *naman* (AnderBois, 2016). The proliferation of such lexical items suggests uncontroversiality-marking to be a widely attested property of natural languages. This in turn raises the question of whether expressions of uncontroversiality have a unified semantics and pragmatics, or whether there is cross-linguistic variation.

In this paper, we contribute to the typological study of uncontroversiality by looking at *of course*. We argue that *of course* is a not-at-issue, focus-sensitive discourse particle that marks

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[2]*Of course* may also be used as a response particle on its own or with *not*:
(i) A: Did Maude make her famous kumquat strudel for the potluck?
B: **Of course** (not).
While we believe that *of course* in these uses contributes a similar semantic and pragmatic meaning, we set them aside here. See Kroll and Roberts (2019) for an analysis that derives these responses via ellipsis.

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a proposition as more likely than its focus alternatives for the speaker. We also show that the apparent addressee uncontroversiality associated with *of course* arises from general pragmatic principles involving assumptions of shared beliefs and reasoning, rather than being part of its lexical semantics. Last, we show that while *of course* demonstrates similarities to the German modal particles *doch* and *ja*, its behavior is distinct from that of the German particles and therefore cannot be fully captured under existing analyses. We believe that this cross-linguistic variation in behavior suggests that uncontroversiality is an interesting locus of cross-linguistic variation.

The paper proceeds as follows. In §2, we provide an overview of the contexts in which *of course* is and is not felicitous. Section 3 compares *of course* with the well-studied German modal particles *doch* and *ja*. In §4, we present an analysis in which *of course* presupposes that a proposition is uncontroversial for the speaker and generates a pragmatic inference that the proposition is uncontroversial for the addressee. We additionally show how this analysis accounts for the distribution observed in §2. Section 5 discusses some additional open questions, and §6 concludes.

2. Empirical Ground

This section lays out the empirical ground of *of course*. We first show that *of course* is a positionally-variable, not-at-issue particle that appears in assertive responses to questions and to declaratives. We then show that *of course* communicates the uncontroversiality of a proposition for the speaker of the utterance, but not necessarily for the addressee(s) of the utterance.

2.1. Compatible sentence types

Of course is felicitous only in declarative sentences like (2). It is not compatible with imperatives (3), questions (4), or exclamatives (5).[3]

(2) a. Fran cleaned her room of course.
    b. Of course Fran cleaned her room.

(3) a. *Of course clean your room!
    b. *Clean your room of course![4]

(4) a. *Did you of course clean your room?
    b. *Did you clean your room of course?

(5) a. *Of course what a clean room you have!
    b. *What a clean room you have of course!

We account for this pattern by proposing that *of course* requires a propositional argument (see §4).

[3] *Of course* can also be prosodically separated from its containing sentence by ‘comma intonation’ (Potts, 2005a). For simplicity, we restrict our focus here to uses of *of course* in which it is prosodically integrated, i.e., cases in which there is no such intonational separation, though we acknowledge that a full empirical account would need to grapple with the subtle and interesting issues raised by prosodic breaks.

[4] Note that an exchange like: *What should I do? Clean your room of course!* is not clearly an imperative, as opposed to an elliptical response derived from a non-imperative construction.

2.2. Distribution in discourse

Of course generally requires prior discourse context to be felicitous. It can be used in responses to questions and to assertions; crucially, however, the position in which it occurs is sensitive to the form of the preceding discourse move.

2.2.1. Responses to questions and assertions

Of course occurs naturally in responses to various discourse moves. For instance, *of course p* is felicitously used in responses to assertions. It can be used in an utterance that either confirms the preceding assertion or disagrees with it, although the disagreeing utterance can in certain contexts be construed as rude or aggressive.

(6) A: Maude made her famous strudel for the potluck.
B: Of course she did(?n't).

Of course can also be used in responses to polar questions, and can be used in a response of positive or negative polarity.

(7) A: Did Maude make her famous strudel for the potluck?
B: Of course she did(n't).

It can also be used in responses to wh-questions:

(8) A: What did Maude make for the potluck?
B: Her famous strudel of course!

Impressionistically, *of course* across all of these examples emphasizes the answer/response by indicating that the information is somehow **obvious** or **uncontroversial** to all conversational participants.

Notably, however, *of course* can be used in certain non-canonical discourses to emphasize this obviousness to the speaker in particular. For example, *of course* is quite natural when the speaker has a sudden realization, as in (9), and in responses to so-called *quiz questions*, in which the asker is interpreted not as genuinely seeking information but rather testing the knowledge of the askee, as in (10):

(9) *Speaker is struggling to solve a math problem on the blackboard, then realizes which formula she needs to quickly find the answer.*
The answer is 7 of course!

(10) Game show host: What is the capital of Estonia?
Contestant: Tallinn of course.

2.2.2. Positional variability

Of course is also variable in terms of its syntactic position. It sometimes prefers to sit sentence-finally, and sometimes prefers to sit sentence-initially.[5] However, there are constraints on when *of course* can appear in each position. In responses to polar questions and declaratives, *of course* generally prefers to sit sentence-initially:

(11) A: Did Maude make her famous strudel for the potluck?
B: Of course she did.
B': ?She did of course.

(12) A: Maude made her famous strudel for the potluck.
B: Of course she did.
B': #/??She did of course.

But in responses to wh-questions, it generally prefers to sit sentence-finally.

Wh-questions:

(13) A: What did Maude make for the potluck?
B: #Of course her famous strudel!
B': Her famous strudel of course!

We return to this asymmetry below in §5.

2.3. (Not-)At-Issueness

We argue that *of course* is a not-at-issue discourse particle (Potts 2005b; Simons et al. 2010; Murray 2010; Rett 2018; a.m.o.). Not-at-issue content generally is not embeddable, projects past negation and propositional attitude verbs, and cannot be easily targeted by direct rejection. *Of course* must modify a matrix clause and cannot be embedded under a non-quotative reading, as demonstrated below.

(14) A: Will Maude make her famous strudel for the potluck?
B: #Elaine thinks that of course she will.

Of course is also speaker oriented and projects past propositional attitude verbs, as in (15).

(15) A: Will Maude make her famous strudel for the potluck?
B: Elaine thinks that she will of course.
Possible interpretation: Of course Elaine thinks that Maude will.
Impossible interpretation: #Of course Maude will, thinks Elaine.

Last, the content contributed by *of course* cannot easily be rejected directly.

(16) Q: Will Maude make her famous strudel for the potluck?
A: Of course Maude will make her famous strudel for the potluck.

[5]It can also sometimes sit sentence-medially, but we focus here on its use in initial and final positions. When sentence-medial, it generally sits between larger constituents. Further exploration is needed to determine whether it is merged in this internal position or undergoes movement.

B: No! She will make an apple pie.
B': #No! It can't be obvious to you that she will make a strudel.[6]

2.4. Focus Sensitivity

Of course also associates with focus, which becomes clear upon examining its interpretation in responses to *wh*-questions. It has long been observed that in responses to constituent questions, focus falls on the constituent that corresponds to the *wh*-word in the interrogative form (Halliday, 1967; Rooth, 1992; Roberts, 1996). This pattern is called *Question-Answer Focus Congruence*. For example, in (17), focus only felicitously falls on the subject.

(17) Q: Who plays the bassoon?
A: ELAINE$_F$ plays the bassoon.
A': #Elaine plays the BASSOON$_F$.

This pattern influences the focus alternatives in responses with *of course*. When *of course* is used in a response to a question or assertion, the relevant comparison set – the set of propositions that *p* is 'uncontroversial' compared to – is determined by which constituent receives focus.[7] For example, focus (realized by focal pitch accent) on different constituents in (18) changes the focus alternatives (in the sense of Rooth 1992) to which *p* is compared:

(18) a. Who plays the bassoon?
[ELAINE]$_F$ plays the bassoon of course. (As opposed to John, Mary,...)
b. What does Elaine do with her bassoon?
Elaine [PLAYS]$_F$ her bassoon of course. (As opposed to waxes, eats,...)
c. What instrument does Elaine play?
Elaine plays the [BASSOON]$_F$ of course. (As opposed to the theremin, the zither,...)

We derive focus alternatives formally below, following Rooth (1985, 1992):

(19) $[\![\text{[Elaine]}_F \text{ play the bassoon}]\!]^f = \{\text{x } \textbf{plays b} \mid \text{x} \in \text{E}\}$.[8]

The interpretation of (19) is that it is obvious or uncontroversial that Elaine plays the bassoon, as opposed to any other individual in some contextually determined set.

Focus alternatives are derived similarly when focus falls on an object, as in (20).

(20) *Three of our friends are trying out for an orchestra. I know they all play different instruments, but I don't know who plays what. I can ask:*
A: Which instrument does Elaine play?
B: Elaine plays the [BASSOON]$_F$ of course.

We predict that *of course* is marking the proposition $\{w$: Elaine plays the bassoon in $w\}$ as uncontroversial compared to the propositions created by the focus alternatives of (20), given

[6]A wrinkle: *Of course* can be used to respond to a Question under Discussion (QUD) (Roberts, 1996; Ginzburg, 1996), especially in its bare response use, in which it behaves similarly to a polarity particle. Please see Kroll and Roberts (2019) for additional discussion.
[7]We tentatively propose that *of course* falls under Beaver and Clark's (2008) *free association* with focus, though additional work remains to be done on this question.
[8]Contextual domain restriction assumed.

below in (21):

(21) $[\![\text{Elaine play the [bassoon]}_F]\!]^f = \{\textbf{e plays}\ \text{x}\ |\text{x} \in \text{E}\}$.

The interpretation of (20) is that it is obvious or uncontroversial that Elaine plays the bassoon, as opposed to any other instrument in some contextually determined set.

In the previous examples, it is clear from Question-Answer Focus Congruence where focus will fall in responses to the questions. In responses to polar questions or declaratives, the placement of focus is less immediately apparent. We propose that in responses to polar questions and declaratives, focus is realized as verum or polarity focus with a focal pitch accent on *of course* itself (Höhle, 1992). For example, in (22), realizing focus as verum or polarity focus yields the alternative propositions $\{w$: Elaine plays the bassoon in $w\}$ and $\{w$: Elaine does not play the bassoon in $w\}$.

(22) Does Elaine play the bassoon?
[OF COURSE]$_F$ Elaine plays the bassoon.

The response in (22) indicates the obviousness of Elaine's playing the bassoon as opposed to her not playing the bassoon.

2.5. Perspective

While it is clear at this point that *of course p* communicates that *p* is somehow obvious or uncontroversial, we have not yet specified for whom *p* must be obvious/uncontroversial. Is it the speaker, the addressee, or both? After all, what is obvious to one person need not be so to another.

The requirement on speaker-oriented uncontroversiality is apparent. First, it is infelicitous for a speaker to use *of course* to modify a proposition whose information is surprising or unexpected to them:

(23) *Maude has always brought desserts and nothing else to potlucks: strudels, pies, whatever dessert you can think of, but never anything else. After a recent potluck, Beatrice is talking with Amy:*
A: Bummer I missed the last potluck, how was it?
B: It was good. Maude brought a rack of lamb (#of course).

Additionally, it is infelicitous for a speaker to use *of course* to modify a proposition whose information they are unsure of:

(24) *Amy and Beatrice are at a potluck. There are some cookies on the table and Amy is a strict vegan.*
A: Are the cookies vegan?
B: Of course they are! I made them with you in mind.
B': ??/#Of course they are! John made them and he probably remembered that you're a vegan.

Based on the examples we have seen thus far, a natural hypothesis is that *p* must be obvious to both the speaker and the addressee; in fact, Holmes (1988) explicitly defines the meaning of *of course* as providing "an overt signal that the speaker is assuming that the hearer accepts or is already familiar with the propositional content of her or his utterance" (pg. 53). However, while intuitive, we can see that this can't be quite correct. For instance, we have seen that *of course* is felicitous in responses to sincere information-seeking questions, such as (25), for which the response is not in the common ground. Making the case even more strongly, we have also seen that *of course* is felicitous in responses that contradict a preceding assertion, as in (26).

(25) *Alphonse and Bartholomew are discussing politics. Alphonse doesn't follow the news.*
A: Who won the election?
B: Mary did of course.

(26) A: John will never come to the party.
B: Of course he will! He never misses a chance for free hors d'oeuvres.

In these examples, B seems to suggest that A *should have* known something—that Mary was the winner in (25) and that John will attend the party in (26)—but not that they **did** know. If *of course* presupposes that the addressee finds *p* uncontroversial, we incorrectly predict that B's responses in (25) and (26) would be infelicitous.

There are at least two additional uses in which information regarding *p* is not presupposed to be available to the addressee. In these cases, the speaker does not even clearly indicate that the addressee *should have* known something. We call these two uses the *confidential* and *concessive* uses, following Holmes (1988) and Quirk et al. (1972), respectively.

***Confidential* uses**

Confidential uses are those in which the speaker signals shared attitudes or knowledge regarding *p* with the addressee even when the speaker is aware that no such shared knowledge exists. This is done as a way to signal camaraderie and in-group membership. A canonical context for the confidential use of *of course* is in a sequence of instructions, as in (27):

(27) *Mary, teaching John to drive a manual:*
You press the clutch to shift into first gear, and then *of course* you press the clutch again to brake to a stop.

***Concessive* uses**

Another use of *of course* is the *concessive* use, in which the speaker signals she is about to proffer additional relevant information on a particular topic.

(28) A: Who is trying out for the available orchestra seat?
B: John is. Of course, so is Elaine.

Informally, in the concessive usage of *of course*, the proposition following *of course* is presented as being potentially relevant additional information for satisfying a particular conversational goal, such as addressing a QUD. In the case of (28), B begins to answer A's question by pointing out that John is trying out, but indicates that A should not assume that means he's a shoo-in for the spot by pointing out that, *of course*, Elaine is also a possibility. Crucially, B is by no means insinuating that A should have known or did know that Elaine was trying out for the orchestra, but merely that it is important information to keep in mind.

2.6. Interim Summary

We have so far presented evidence that *of course* is a focus-sensitive, positionally variable, not-at-issue response particle that marks a proposition *p* as uncontroversial/obvious for the speaker, but not necessarily for the addressee. In the next section, we show that the behavior of *of course* is distinct from the behavior of the German particles *doch* and *ja*.

3. Comparison to German modal particles *doch* and *ja*

While *of course* has received comparatively little attention by theoretical linguists, the superficially similar German discourse particles *doch* and *ja* are quite well-studied. Like *of course*, *doch* and *ja* have been argued to mark information as 'obvious' or 'uncontroversial' (Kratzer and Matthewson 2009; Grosz 2010; Zimmermann 2011; Kaufmann and Kaufmann 2012; Kraus 2018; a.o). This makes existing work on *doch* and *ja* a compelling starting point for an analysis of *of course*. However, we show that while *of course* expresses a similar meaning as the German particles, its use is distinct from *doch* and *ja* in several ways, and therefore cannot be straightforwardly folded into the analysis of one or the other.

3.1. *Doch*

Most accounts of *doch* argue that it introduces a Stalnakerian presupposition that its modified proposition is uncontroversial, and that, additionally, this uncontroversial proposition is somehow contradictory to previous information in the discourse. Authors vary in how exactly they cash out this presupposition of $doch(p)$.

For Grosz (2010), *p* is an 'established fact' and has a salient focus alternative *q* which contradicts *p*. For Kaufmann and Kaufmann (2012), the notion of uncontroversiality is inextricably tied to that of *normalcy*. What it means for a proposition to be uncontroversial in a particular situation *c* is that *normally*, any rational agent who wishes to find out whether *p* in a situation *c* is able to do so using information that is already known or in the immediate vicinity of the conversation. They additionally propose that *doch* presupposes that *c* is *not* normal in this way – in other words, any agent *should* be able to determine whether *p* in the discourse context, but they cannot, for whatever reason. Rojas-Esponda (2013), on the other hand, proposes that *doch p* presupposes that the current QUD was previously closed (either unanswered or shown invalid).

Whatever the details of a sufficient analysis of *doch*, it quickly becomes clear that an account of *doch* cannot be directly applied to *of course* for two reasons. First, *doch* can appear in imperatives, unlike *of course*:

(29) a. *Ruf* *ihn* ***doch*** *an!*
call.IMP him DOCH VPREF
'(Just) call him!' (Kaufmann & Kaufmann 2012: 214)
b. *Call him of course!

Second, and perhaps more critically, *doch* can be used in situations where reality contradicts the way the things 'normally' are; however, *of course* is felicitous only when the state of affairs is consistent with the speaker's expectations. Thus, the utterance in (30b) is infelicitous, because the neighbors' actions are inconsistent with the proposition expressed by *today is Sunday*:

(30) Context: I wake up on a Sunday at 6AM because the neighbors are drilling.
   a. *Heute ist* ***doch*** *Sonntag!*
      today is DOCH Sunday
      'But today is Sunday!' (Grosz 2010: 4)
   b. #Today is Sunday of course!

To summarize, while *doch* shares a core of 'uncontroversial' meaning with *of course*, it additionally conveys that the uncontroversial proposition is somehow contrary to expectations or established fact, whereas *of course* is incompatible with such situations.

3.2. *Ja*

Ja has also been argued to express a meaning of uncontroversiality overlapping with that of *doch*. Kaufmann and Kaufmann (2012) and Grosz (2010) both explicitly analyze the uncontroversial component of *ja*'s meaning as being identical to that of *doch*. For Grosz, this is the end of the story: *ja* is strictly weaker than *doch*. For Kaufmann & Kaufmann, *ja(p)* additionally presupposes that the conversational context is 'normal' in the sense delineated above – i.e., that anyone who wishes to find out whether *p* can do so from information readily available in the context.

On the other hand, Viesel (2015) and Kraus (2018), following earlier work, claim *ja* takes two propositional arguments – a proposition *p* which is uncontroversial, and the other representing a discourse move explained by *p*. In other words, *ja(p)* is used to point out that *p* is to be expected given some other body of evidence.

At first brush, this makes *ja* appear to be kith and kin with *of course*, as both mark a proposition as being uncontroversial or obvious. However, *ja* and *of course* differ in two important empirical ways. First, while *ja p* can be used whenever *p* is known to all discourse participants, regardless of where evidence for *p* came from, *of course p* is infelicitous if the speaker's only evidence for *p* is from the immediate context of the discourse.

(31) The speaker sees the addressee for the first time in bright sunlight and realizes the addressee's eye color.
   a. *Du hast* ***ja*** *grüne Augen!*
      you have JA green eyes
      'You have JA green eyes!' (Grosz 2010: 7)
   b. #Of course you have green eyes!/You have green eyes, of course!

An utterance of (31b) is only felicitous if the speaker has some reason to expect that the addressee would have green eyes *before* they actually saw the addressee's eyes, e.g., if the speaker knows the addressee's family all has green eyes. This same expectation is not conveyed by the use of *ja*.

The second difference is that *ja* may be used to introduce information that is new to the addressee only in the event that it is manifest to, or is able to be confirmed by, the addressee (Kraus, 2018). However, as we have shown, *of course p* does not require that *p* is known or available to the addressee. As shown in (31), the use of *of course* is felicitous only if *p* contains information that the speaker had some independent reason to expect. For example, while *ja* is acceptable in (32b), *of course* is acceptable only if the speaker knows that, for example, the addressee is extremely clumsy, and so their spilling was somehow expected based on this knowledge.

(32) *The speaker notices that the addressee has spilled coffee on her shirt.*
a. *Du hast **ja** gekleckert.*
you have JA spilled
'You've spilled, you know.' (Kraus 2018: 272)
b. #You've spilled, of course.

3.3. Summary

We have shown in this section that, while *of course* shares an important core meaning of uncontroversiality with *doch* and *ja*, its usage differs in crucial ways. Unlike *doch p*, *of course p* does not convey that *p* is unexpected – and in fact, rather the opposite. Unlike *ja p*, *of course p* does not necessitate that the speaker believes that the addressee already believes or can immediately verify *p*, and *of course p* requires that the uncontroversiality of *p* be based on some information beyond that which is immediately accessible in the conversational context. Therefore, while all three particles have a degree of overlap in meaning, an analysis of *of course* cannot simply be collapsed into analyses of *doch* or *ja*. The next section presents and motivates an analysis of *of course* in which uncontroversiality is defined in probabilistic terms.

4. Analysis

We propose that *of course* marks a proposition *p* as **uncontroversial** for the speaker, as given in (33):

(33) Definition 1: When a speaker *s* utters *of course p*, she 1) asserts *p* and 2) presupposes that *p* is **uncontroversial** for *s* in the conversational context.

This section formally defines our notion of uncontroversiality, and demonstrates how it interacts with focus and general pragmatic reasoning to derive the possible interpretations of *of course* in different contexts.

4.1. Uncontroversiality

What does it mean for a proposition to be uncontroversial? With respect to *ja*, existing analyses converge on uncontroversiality as being a property of a proposition that holds for all speakers in a discourse. Kaufmann and Kaufmann (2012), for instance, indicate that a proposition *p* is uncontroversial if any rational agent under normal circumstances who wishes to find out whether *p* does so from readily available information. Similarly, the definition for *ja* given by Kraus (2018) makes explicit that *ja(p)* is licensed only when the speaker believes that everyone in the conversational context would expect *p* to be true.

While this intuitively aligns with the interpretation of *of course* in many contexts, the semantic imposition of the uncontroversiality of *p* on all conversational participants is too strong, as it does not allow us to capture the uses of *of course p* in which the speaker believes that *p* is not known to the addressee. Furthermore, it is clear from examples like (31) that *of course* poses certain restrictions on what evidence can be under consideration for calculating the obviousness of p. Finally, as we saw in §2, we argue that *of course* is sensitive to focus, and that it is empirically desirable to capture the intuition that *of course* marks a proposition as uncontroversial *relative to its focus alternatives*.

Our solution for the first problem lies in relativizing uncontroversiality of a proposition to individual discourse participants. In this way, *of course p* can mark p as uncontroversial for the speaker, while leaving room for the speaker to not impose such a requirement on the addressee.

We define uncontroversiality formally using a probabilistic framework (Yalcin, 2010; Lassiter, 2011). In this framework, beliefs are modeled as functions from ⟨world, time, speaker⟩ triples to epistemic probability spaces $\langle E_{stw}, Pr_{stw}\rangle$, defined below.

1. E_{stw} is the set of propositions epistemically accessible from a speaker s, at time t, in a world w. $\bigcap E_{stw}$ provides the set of epistemically accessible worlds.
2. Pr_{stw} is a function from a finite set of possible worlds W to [0,1], where (i) $Pr_{stw}(\bigcap E_{stw}) = 1$, and (ii) $Pr_{stw}(p \cup q) = Pr_{stw}(p) + Pr_{stw}(q)$ if p, q are disjoint. A function g_{stw} maps from speaker, world, time triples to probability spaces.
3. Speakers assign probability distributions over an epistemic base E_{stw} via Bayesian conditioning, updating their distribution whenever they receive new relevant information.

A natural treatment of uncontroversiality in this framework is that a proposition p is uncontroversial simply if the speaker considers p more likely than its focus alternatives given what they know, as in (34):

(34) Definition of uncontroversiality (preliminary):
A proposition p is uncontroversial for a speaker s at time t given an epistemic probability space $\langle E_{stw}, Pr_{stw}\rangle$ and a contextually given probability threshold θ on (0,1], for all $q \in [\![p]\!]^f$, $Pr(p) - Pr(q) > \theta$.

But while this definition is promising, it is still not quite what we need. This formulation does not place any restrictions on the source of evidence for p, and thereby undesirably predicts *of course* to be licit in contexts where the speaker is committed to p but only on the basis of evidence in the discourse context. Instead, we need to capture the intuition that the probability of p when uttering *of course p* does not include evidence the speaker might have for p that was gathered at the utterance time.

More precisely, it seems that the information which the speaker has for p has to come from what she presents herself as believing is shared *background* knowledge with the addressee. We may think of the relevant knowledge base as being a subset of the speaker's epistemically accessible worlds, but restricted only to those propositions which were already accessible prior to the conversational context. We therefore modify our definition of uncontroversiality as follows:

(35) Definition of uncontroversiality (final):
Let R be the set of all propositions r in E_{stw} such that r is a proposition given by general shared beliefs, education, world-knowledge, or in-group social knowledge.
A proposition p is uncontroversial for a speaker s at time t given an epistemic probability space $\langle R, Pr_{stw}\rangle$ and a contextually given probability threshold θ on (0,1], for all $q \in [\![p]\!]^f$, $Pr(p) - Pr(q) > \theta$.

Why probability?

Although we believe the probabilistic formalization given here for uncontroversiality is suitable for our needs, nothing crucial in our analysis rests on this particular choice of framework. We choose to define uncontroversiality probabilistically for two main reasons. For one, *of course* p can be felicitously uttered for some speakers even if p is less likely than $\neg p$, as long as p is nonetheless much more likely than any one alternative.

(36) *A lottery is taking place in which a integer from 1-100 is selected. 1 is 49% likely to be selected, and 2-100 are all equally likely as one another.*
A: Which number will they pick?
B: #They'll pick 1.
B': %They'll pick 1, of course.

While English speakers do not universally accept the B' response in (36), this is not surprising, since different speakers may not agree on a value for θ in a given context. Strikingly, however, there seems to be a preference for the B' response over the B response, which lacks *of course*. This is perhaps because *of course* makes explicit the comparison between p and its focus alternatives.

Second, it is not sufficient to say that p simply needs to be more likely than its focus alternatives to license *of course*; the difference in likelihood must be significant:

(37) *Same lottery, except 1 is 2% likely to be selected, and 2-100 are still equally likely as one another.*
A: Which number will they choose?
B: #They'll pick 1, of course.

In (37), even though 1 is a more likely choice than any alternatives, its likelihood doesn't exceed that of the alternatives by all that much. Instead, we argue that $Pr(p)$ must exceed $Pr(q)$ for all the focus alternatives of p, $q \in [\![p]\!]^f$, by a contextually-determined margin. Therefore, a proposition with a low probability that is nonetheless more probable than its alternatives is not necessarily felicitously marked with *of course*.

4.2. Deriving Addressee Uncontroversiality

In §2, we observed that *of course p* often suggests that p is or should also be obvious/uncontroversial to the addressee as well as to the speaker. However, we also showed that addressee uncontroversiality is defeasible, and therefore cannot be included in the semantics of *of course*. Instead, we propose that the addressee effects are derived pragmatically by a defeasible inference generated by *of course*. We call this inference the *Shared Background Assumption*.

(38) **Shared Background Assumption (SBA)**:

1. *Of course p* presupposes that p is uncontroversial for the speaker in w at t.
2. In a given w and t, the speaker may believe that they and the addressee(s) share equal access to R, given that R by definition consists of propositions which the speaker takes to be common knowledge.
3. If the speaker assumes the addressee(s) have equal access to R, a pragmatic inference

is generated that *p* is or should be, based on this shared information, uncontroversial for the addressee as well as for the speaker.

4.2.1. When does the Shared Background Assumption hold?

The assumption that the speaker and addressee have access to the same information regarding the probability of *p* is not a hard requirement on the context; that is, it is not an entailment. We know that the Shared Background Assumption must be defeasible because there is not necessarily conversational infelicity when *of course* is used to modify a proposition that is not uncontroversial for the addressee, as we saw above. Instead, the Shared Background Assumption is context sensitive and depends on assumptions of the shared background between different speakers.

For example, in (39), whether speakers judge *of course* in Bartholomew's response as a) implying that Alphonse should have known the answer, or b) emphasizing that the Patriots will win, appears to correlate with their beliefs about how much people generally know about football. If a speaker assumes that Alphonse and Bartholomew share knowledge that the Patriots are a more successful football team than the Detroit Lions (on average), then they interpret Alphonse's statement as implying that Bartholomew should have known the answer to the question. However, if a speaker doesn't assume that Alphonse and Bartholomew share this background knowledge, then Bartholomew's response is interpreted only as emphasizing the uncontroversiality of the proposition that the Patriots will win.

(39) *Alphonse and Bartholomew are discussing an upcoming football game between the Patriots and the Detroit Lions.*
A: Who will win the game?
B: The Patriots will of course.

The context sensitivity of R can also explain Holmes' (1988) *manipulative* use of *of course*, in which the speaker may 'sneakily' propose a controversial discourse update:

(40) [Prime Minister Robert Muldoon in a TV interview]
yes well Marilyn's got a thing about middle-aged males *of course* (ibid., 59)

(41) Asbestos is harmless in walls *of course*.

In these cases, the speaker does not truly believe that their addressees share the same background information for these utterances, but presents themselves as such. An addressee may naturally take the speaker's apparent assumption that their controversial choice of *p* is in *R* as an indication that *p* is something they should adopt in their own beliefs.

4.2.2. Comparison to *obviously*

The unilateral uncontroversiality requirement of *of course* may also explain differences between *of course* and similar particles such as *obviously*. For example, using *obviously* in a response to a sincere information-seeking question is generally considered rude, whereas *of course* in the same context need not be.

(42) A: What time is it?
B: 7 o'clock, obviously.
B': 7 o'clock, of course.

Assuming B' takes A's inquiry to be genuinely seeking information, she knows that the SBA cannot hold, and *of course* does not generate the inference that A knew the time. If *obviously p* requires uncontroversiality (or something similar) to hold of the addressee as well as the speaker, then the rudeness of B's answer in (42) is expected, as B's assumption that the current time is uncontroversial for A is at odds with A's question.

5. Further Questions

Although our denotation for *of course* is broadly able to account for what kind of discourse moves it can occur in, there remain issues about its distribution that our account does not fill in. In this section we raise some of these concerns and propose possible avenues for investigation.

5.1. Whence positional variability?

Recall that in §2 we observed that *of course* displays positional effects, whereby it is not always interchangeable sentence-initially and sentence-finally. As we observed, *of course* is preferentially sentence-initial in response to declaratives or polar questions.

(43) A: Did Maude make her famous strudel for the potluck?
B: Of course she did.
B': ?She did of course.

(44) A: Maude made her famous strudel for the potluck.
B: Of course she did.
B': #/??She did of course.

However, in responses to wh-questions we observed that it generally prefers to sit sentence-finally.

(45) A: What did Maude make for the potluck?
B: #Of course her famous strudel!
B': Her famous strudel of course!

We believe that this difference is not syntactic or semantic in nature, but is due to **prosodic** and **information structural** constraints. The main reason we believe the distribution is not syntactically or semantically constrained is that placing *of course* in initial position in responses to wh-questions improves when certain conditions are met. For example, initial *of course* is judged felicitous in responses to wh-questions in which the focused element receives contrastive focus (Zimmermann, 2008):

(46) A: Who's going to come to the party?
B: Of course ELAINE will, but Matt won't.
B': ELAINE will of course, but Matt won't.

B's response is realized with the low surprise/redundancy contour, L*H*+L% (Kraus, 2018).

Of course is also judged acceptable by some speakers in initial position in responses to wh-questions whose set of possible answers is extremely restricted. For example, suppose that Maude was agonizing over whether to bring a strudel or cookies to the potluck. After the event, A can ask:

(47) A: Which dish did Maude end up taking to the potluck?
B: %Of course (she took) her strudel.

B's response is most acceptable with a pitch accent on *strudel* and a secondary accent on *of course*.

Because the positional preferences are sensitive to focus placement and to intonational contours, we believe the explanation for the effects lies in the domain of prosodic and information-structure well-formedness. Ongoing work is investigating these properties in greater detail.

5.2. Intonational Differences Across Uses

Closely related to the observations of the previous subsection are questions of how different intonational contours map onto different uses of *of course*. For example, the concessive use that we discussed in §2 has a distinct prosodic contour in which the stressed vowel of *of course* naturally undergoes mirative lengthening (Kraus, 2018). That is, in (48) the stressed vowel in *course* can be optionally lengthened compared to the stressed vowel in *course* in (49).

(48) Concessive use:
A: Who is trying out for the available orchestra seat?
B: John is. Of course, so is Elaine.
B': John is. Of co:urse, so is Elaine.

(49) Polar question:
A: Is Elaine trying out for the orchestra?
B: Of course she is!
B:' ??/#Of co:urse she is!

We leave this interesting question for future investigation.

6. Conclusion

We have argued that *of course* presupposes that a proposition is 'uncontroversial' – significantly more likely than its focus alternatives and supported by evidence outside of the immediate discourse context – for the speaker. We have also shown that the intuition that *of course* signals *p* is uncontroversial for the addressee as well as for the speaker arises from a general pragmatic principle involving assumptions of shared beliefs and reasoning, rather than being part of *of course*'s semantics.

One contribution of our account is that it relies on a notion of uncontroversiality that is relativized to individuals, rather than being a property of propositions that must be satisfied by all discourse participants. This suggests that a one-size-fits-all approach to uncontroversiality is too broad to capture the nuances exhibited by different particles cross-linguistically, and that multiple detailed definitions of uncontroversiality are needed for full empirical coverage.

There is still much work to be done on sharpening the typological picture of uncontroversiality. How completely our account can extend to additional markers of uncontroversiality remains an exciting area of future inquiry. For example, our analysis allows for the possibility that, in addition to particles which signal uncontroversiality for the speaker alone, there are also particles which signal uncontroversiality for the addressee. Further work is also needed to determine the extent to which uncontroversiality interacts with other mechanisms for evidence-marking, such as sentential prosodic contours (Kraus, 2018; Goodhue and Wagner, 2018). We leave a detailed response to these interesting questions for future research.

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A 'situated' solution to prior's substitution problem[1]

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Abstract. In the complements of many DP/CP-neutral attitude verbs (e.g. remember, fear, see), CPs resist the truth-preserving substitution by a DP of the form 'the proposition $[_{\mathrm{CP}}\ ]$'. This substitution is often perceived as involving a shift in verb-reading from a reading in which the semantic value of the complement serves as the *content* of the attitude to a reading in which it serves as the *object* towards which the attitude is directed (see Moltmann's 2003 *objectivization effect*). This paper provides a uniform account of the above phenomena that uses the particular pragmatic properties of the situation that serves as the internal argument of the attitude report. The resulting account is inspired by Pietroski (2000) and Forbes' (2018) account of the objectivization effect and by Moltmann's (2003) 'unique determination'-strategy for the explanation of DP/CP substitution behavior. The account improves upon other accounts by explaining *both* the substitution behavior and the objectivization effect, and by explaining the validity (for some verbs) of the CP's substitution by DPs like 'the fact $[_{\mathrm{CP}}\ ]$' or 'the possibility $[_{\mathrm{CP}}\ ]$'.

Keywords: Intentional attitude reports, DP/CP complement-neutral verbs, CP nominalizations, substitution failure, objectivization effect, distributional differences between complements.

1. Introduction

1.1. DP/CP substitution behavior

In the complements of most DP/CP-neutral attitude verbs, CPs resist the truth-preserving substitution by a DP of the form 'the proposition $[_{\mathrm{CP}}\ ]$' (see a.o. Vendler, 1967; Prior, 1971; Parsons, 1993; King, 2002; Moltmann, 2003, 2013; Forbes, 2018). This holds for epistemic verbs[2] like remember, notice, discover, and regret (see (1)), for quasi-perceptual intentional and emotional verbs like imagine, hallucinate, fear, and suspect (see (2)), and for perception verbs like see, hear/overhear, feel, and sense (see (3)):

(1) a. Pat remembers $[_{\mathrm{CP}}$ that Bill bought a sports car$]$.
$\not\equiv$ b. Pat remembers $[_{\mathrm{DP}}$ the proposition $[_{\mathrm{CP}}$ that Bill bought a sports car$]]$.

(2) a. Pat fears $[_{\mathrm{CP}}$ that Bill will try to hug her$]$.
$\not\equiv$ b. Pat fears $[_{\mathrm{DP}}$ the proposition $[_{\mathrm{CP}}$ that Bill will try to hug her$]]$.

(3) a. Pat sees $[_{\mathrm{CP}}$ that Bill is waiting for her$]$.
$\not\equiv$ b. Pat sees $[_{\mathrm{DP}}$ the proposition $[_{\mathrm{CP}}$ that Bill is waiting for her$]]$.

In the complements of these verbs, the substitution of a CP by a DP of the form 'the proposition $[_{\mathrm{CP}}\ ]$' yields a (semantically acceptable) sentence that has different – often less natural – truth-conditions than the original sentence. For example, while it is easy to imagine conditions under

[1]I wish to thank Alex Grzankowski, Jan Köpping, Dolf Rami, Rachel Rudolph, Chris Tancredi, Thomas Weskott, Ede Zimmermann, and my reviewers for *Sinn und Bedeutung 23* and *Cognitive Structures 2018* for valuable comments and feedback about the content of this paper. The situation semantics in Sect. 2.2 originates from joint work with Markus Werning (see Liefke and Werning, 2018). The research for this paper is supported by the German Research Foundation (via Ede Zimmermann's grant ZI 683/13-1).

[2]For further examples of DP/CP substitution-resisting attitude verbs, the reader is referred to (Moltmann, 2003: 82–89) (see Moltmann, 2013: 126–132) and (Forbes, 2018).

Proceedings of Sinn und Bedeutung 23, vol. 2, pp. 55–72. Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès).

which (1a) and (2a) are true, many of the conditions under which (1b) and (2b) are true are rather contrived (see Moltmann, 2003: 82; King, 2002: 344). Worse, while (3a) is true in many conceivable contexts, (3b) is (likely) not true in any contexts (i.e. it is necessarily false).

Some members of the above-described class of verbs allow the truth-preserving substitution of their CP complement by a DP of the form 'the fact [$_{\text{CP}}$]' or 'the possibility [$_{\text{CP}}$]' (see Parsons, 1993: 453–456; Moltmann, 2003: 83–85; Moffett, 2003: 81–84; Pryor, 2007: 228):

(4) a. Pat remembers [$_{\text{CP}}$ that Bill bought a sports car].
$\equiv$ b. Pat remembers [$_{\text{DP}}$ the fact [$_{\text{CP}}$ that Bill bought a sports car]].
(5) a. Pat fears [$_{\text{CP}}$ that Bill will try to hug her].
$\equiv$ b. Pat fears [$_{\text{DP}}$ (the realization of) the possibility [$_{\text{CP}}$ that Bill will try to hug her]].

This substitutivity also holds for verbs like hope and wish, which take a *prepositional* (rather than a direct) object complement (see (6)) and for verbs like destroy, frighten, and suck, which are neutral between taking a DP and a CP *subject* (see (7)):[3]

(6) a. Bill hoped/wished [$_{\text{CP}}$ that Pat would love him back].
$\equiv$ b. Bill hoped/wished for [$_{\text{DP}}$ the possibility [$_{\text{CP}}$ that Pat would love him back]].
$\not\equiv$ c. ??Bill hoped/wished for [$_{\text{DP}}$ the proposition [$_{\text{CP}}$ that Pat would love him back]].
(7) a. [$_{\text{CP}}$ That the weather is not improving] sucks.
$\equiv$ b. [$_{\text{DP}}$ The fact [$_{\text{CP}}$ that the weather is not improving]] sucks.
$\not\equiv$ c. ??[$_{\text{DP}}$ The proposition [$_{\text{CP}}$ that the weather is not improving]] sucks.

The objectivization effect. In attitude reports like (1) to (3), the truth-conditional difference between the (a)-sentence and the (b)-sentence is often attributed to a shift in the reading of the attitude verb (see Pietroski, 2000; Moltmann, 2003, 2013; Forbes, 2018). This shift changes the reading of the verb from a reading in which the semantic value of the complement serves as the *content* of the attitude (see (8a)) to a reading in which the semantic value of the complement serves as the *object* towards which the attitude is directed (see (8b)):

(8) a. Pat's remembering has as its *content* (the proposition/the fact) that Bill bought a sports car
$\not\equiv$ b. Pat's remembering has as its *object* the proposition that Bill bought a sports car

In (Moltmann, 2003: 86–89) (cf. Moltmann, 2013: 131–132), this shift in reading is called *the objectivization effect*. In particular, since (8a) is not a possible reading of (1b), the inference from (1a) to (1b) is intuitively invalid. Analogous observations hold for the inference from (2a) to (2b) and from (3a) to (3b).

[3] In the complements of intensional, episodic, and evaluative verbs (e.g. seek/look for, encounter, be boring), an analogous observation is made w.r.t. the substitution of bare adjective nominalizations (e.g. ordinariness) by their corresponding explicit property-denoting terms (here: the property of ordinariness) (see Moltmann, 2004: 19; Moltmann, 2013: 15–17; Zimmermann, 2006: 384–385):

($\star$) a. [$_{\text{DP}}$ Ordinariness] is boring.
$\not\equiv$ b. [$_{\text{DP}}$ The property of [$_{\text{DP}}$ ordinariness]] is boring.

Note that the objectivization effect is typically not exemplified by pairs of sentences like (4) and (5). (The salient reading of (4b) is (8a)). However, this effect is exemplified by certain *alternative* readings of the matrix verbs in these sentences.[4] For (4b), this reading is made salient in a context in which the fact (*qua* abstract object) that Bill bought a sports car was a frequent topic of discussion in Pat's *Ontology 101* class. The relevant reading of (4b) is given in (9a):

(9) a. Pat's remembering has as its *object* the fact that Bill bought a sports car
$\not\equiv$ b. Pat's remembering has as its *content* (the fact) that Bill bought a sports car

According to (Moltmann, 2013: 126–127), the objectivization effect is also not exemplified by the few attitude verbs (e.g. mental action verbs[5] like believe and prove) whose combination with a DP of the form 'the proposition $[_{\text{CP}}\ ]$' yields a sentence with natural, i.e. non-contrived, truth-conditions (see also King, 2002: 359–360; Forbes, 2018: 5). These verbs are typically CP-biased verbs that only select for some 'special' (i.e. abstract object-denoting) DP complements like CP nominalizations, the quantifier something, or proposition-names like Goldbach's conjecture.[6] The absence of the objectivization effect in attitude reports containing these verbs is exemplified by the observation that (10a) and (10b) both have (10b.i) as their only reading:

(10) a. Pat believes $[_{\text{CP}}$ that the Earth is round$]$.
$\equiv$ b. Pat believes $[_{\text{DP}}$ the proposition $[_{\text{CP}}$ that the Earth is round$]]$.
  $\equiv$ i. Pat's belief has as its *content* (the proposition) that the Earth is round
  $\not\equiv$ ii. Pat's belief has as its *object* the proposition that the Earth is round

1.2. Challenges and objectives

The substitution behavior of the complements of DP/CP-neutral attitude verbs and the objectivization effect have been the topic of much research in semantics and the philosophy of language. This is due to the difficulty of traditional Montague-style semantics to straightforwardly account for these phenomena. Following (Moltmann, 2003: 82) (see Prior, 1971), we hereafter refer to the inability of these semantics to explain the substitution-resistance of CPs with a DP of the form 'the proposition $[_{\text{CP}}\ ]$' as *the substitution problem*. This problem arises from (i) the traditional analysis of attitude reports as binary relations between individuals/cognitive agents and the semantic values of CPs (see Montague, 1973; cf. Dowty et al., 1981: Ch. 6; Fox and Lappin, 2005), (ii) the identification of the semantic contribution and compositional behavior of CP- and DP-taking occurrences of attitude verbs (see Zimmermann, 2006), and (iii) the identification of the semantic values of CPs with propositions (see Bach, 1997).

The challenge from the above phenomena is reinforced by the observation that none of the newer relational semantics for attitude reports simultaneously explains both the DP/CP-substitution behavior and the objectivization effect:[7] In particular, solutions to the substitution prob-

[4] In this point, we deviate from (Moltmann, 2003: 86–89) (cf. Moltmann, 2013: 131–132), whose examples of the objectivization effect exclude cases like the ones discussed in the context of (9).

[5] Moltmann and Forbes also list the verbs deduce, infer, accept, assume, establish, and assert in this category. However, a simple Google search reveals that these verbs much more frequently combine with DPs of the form 'the fact $[_{\text{CP}}\ ]$' and/or 'the possibility $[_{\text{CP}}\ ]$'. Thus, on March 20, 2018, the string 'deduce the proposition' only yielded 129.000 hits, while the strings 'deduce the fact' and 'deduce the possibility' yielded 2.510.000 resp. 651.000 hits.

[6] As a result, we exclude mental action verbs from the class of DP/CP-neutral verbs.

lem that question the interpretation of CPs as propositions (see Vendler, 1967; Parsons, 1993; Pryor, 2007; Moltmann, 2003) typically cannot (straightforwardly) explain the objectivization effect. Inversely, explanations of this effect that deny the identity of the semantic values of CP- and DP-taking occurrences of attitude verbs (see Pietroski, 2000; King, 2002, 2007; Rosefeldt, 2008; Forbes, 2018) are still unable to solve the substitution problem.

This paper seeks to compensate for the above shortcomings. In particular, it provides a uniform account of DP/CP substitution behavior and the objectivization effect that uses the particular pragmatic properties of the situation or event that serves as the internal argument of the attitude report (for (1a): the properties of Pat's particular *remembered* event (Bill buying a sports car)). Our account is inspired by Forbes' (2018) and Elliott's (2016) accounts of the objectivization effect (cf. Pietroski, 2000) and by Moltmann's (2013) 'unique determination'-strategy for the solution of the substitution problem (cf. Moltmann, 2003: 83–84). Our account identifies Moltmann's instances of the objectivization effect as a special subcase of a more general phenomenon and advances several aspects of the situation semantics from (Liefke and Werning, 2018).

The paper is organized as follows: we start by outlining our strategy for the explanation of (1) to (10) (Sect. 2). The subsequent sections develop those parts of our account that are relevant for our explanation of DP/CP-substitution behavior (Sect. 3) and of the objectivization effect (Sect. 4). Section 5 anticipates and answers several objections to our account. The paper closes with a summary of our results and with pointers to future work.

2. Proposal, motivation, and background

To show the general strategy behind our account – and to identify the relation between the different parts of this account[8] –, we here give a brief sketch of the account:

(i) The proposed account explains the *substitution behavior* of the complements of DP/CP-neutral verbs (see (1)–(7), (10)) by pragmatic constraints on the contextual choice of the situation that serves as the internal argument of the attitude report. For the verb remember, these constraints include the restriction of the remember*ed* situation to a situation (or event) that is located in the world, $w_@$, that is associated with the situation of evaluation, $@$, and that precedes the time of $@$. DP/CP substitution behavior (here: (4)) is then explained through the compatibility of the verb's constraint-profile with the constraint-profile of the DP (for 'the fact $[_{\text{CP}}\ ]$': if p is a fact, then p is true of a spatial part of $w_@$).

(ii) To explain *the objectivization effect* (see (8), (9)), we assume that nominalized CPs are interpreted as the *objects* of attitude verbs when their constraint-profile is not compatible with the constraint-profile of the verb (e.g. in (1b)), or – if their constraint-profile *is* compatible with the constraint-profile of the verb (see (4b)) – when their embedding verb receives an alternative (i.e. object-)reading (i.e. (9a)). Otherwise, they are interpreted as the *contents* of the attitudes described by these verbs.

[7]Zimmermann (2006) can be taken to suggest an alternative account of DP/CP substitution behavior and the objectivization effect that explains these phenomena w.r.t. a difference in LF-structure (and, attendantly, in compositional interpretation). Zimmermann's account distinguishes ($\star$b) from ($\star$a) (see fn. 3) by analyzing ($\star$a) as an instance of subsumption (i.e. $[\![\text{DP}]\!] \sqsubseteq [\![\text{VP}]\!]$: 'all ordinary things are boring things') and analyzing ($\star$b) as an instance of predication (i.e. $[\![\text{VP}]\!]\big([\![\text{DP}]\!]\big)$: 'a certain abstract object is boring'). We leave the transfer of Zimmermann's account to cases like (1) to (3) as the topic for another paper.

[8]These relations give rise to the uniformity of the proposed account.

The remainder of this section introduces the proposed semantics for DP/CP-neutral attitude verbs (in Sect. 2.1) and presents the relevant background of this semantics (in Sect. 2.2).

2.1. 'Situating' attitude complements

To get our proposed semantics off the ground, we use a situation-semantic modification of the traditional interpretation of attitude verbs. Traditionally, attitude verbs (here: believe) are interpreted as relations to propositions, where propositions are represented by sets of possible worlds (type *st*;[9] see (11)). The traditional interpretation assumes that the cognitive agent stands in the described relation to a particular proposition p if p is true in all of his/her attitudinally relevant alternatives (see (12), where $\mathrm{Dox}_{x,i}$ is the set of x's doxastic alternatives in i, i.e. the set of worlds that are compatible with everything that x believes in i; cf. Hintikka, 1969):

(11) $[\![\text{believe}]\!]^i = \lambda p^{st} \lambda x^e\, [believe_i(x,p)]$

(12) $\equiv \lambda p^{st} \lambda x^e\, [\forall j^s.\, \mathrm{Dox}_{x,i}(j) \rightarrow p(j)]$

Hintikka's semantics has today become the standard semantics for propositional attitude reports. However, for the interpretation of many of the verbs from Section 1.1 (incl. remember, notice, and see), this semantics faces a serious shortcoming: in contrast to the complements of believe-type verbs, the complements of the above verbs are typically used to describe a single *particular* situation (or event) – even if the propositional content of the complement is true at other situations/worlds in the set of the agent's relevant alternatives. Hintikka semantics fails to identify this situation. This is especially problematic since, for many of the above verbs, the mentioned situation cannot be identified with (or inferred from) i. For example, the event of Bill buying a sports car that is described by the complement of (1a) presumably did not happen in i, but in a (specific remember*ed*) situation that temporally precedes i.

To capture the above observation,[10] we interpret DP/CP-neutral verbs like remember along the lines of (13). This interpretation treats remember as a relation to a set of situations in which p is true, which approximate the information of the temporal world-slice (or *index*), $\langle w_\sigma, t_\sigma \rangle$, that is associated with the agent's remembered situation/event at i, σ. In (13), σ is a variable over internal situation-arguments. $\langle w_\sigma, t_\sigma \rangle$ (with w_σ a world and t_σ a point in time in w_σ's history)

[9] We hereafter give types in superscript.

[10] Because of the informational completeness of Kratzer-style situations (which are *total* world-parts), the relevant occurrences of remember cannot be interpreted as relations to Kratzer-style situations. Such an interpretation (see (†)) would fail to capture the difference between attitude reports with gerundive complements (e.g. (†a)) – which allow for a 'situation'-reading (see Stephenson, 2010) – and reports with finite clausal complements (e.g. (†b)) – which typically do *not* allow for this reading.

(†) $\exists \sigma^s \exists y^e\, [remember'_i(pat,\sigma) \wedge (buy_\sigma(bill,y) \wedge car_\sigma(y))]$

a. $=$ $[\![$Pat remembers $[_{\mathrm{GC}}$ Bill buying a sports car$]]\!]^i$
(Pat remembers the specific event in which Bill bought a sports car)

b. $\neq$ $[\![$Pat remembers $[_{\mathrm{CP}}$ that Bill bought a sports car$]]\!]^i$
$\equiv$ $[\![$Pat remembers $[_{\mathrm{DP}}$ the fact $[_{\mathrm{CP}}$ that Bill bought a sports car$]]]\!]^i$

Since they allow for the informational depletion of situations to entities that only code the information content of propositions, Liefke and Werning's (2018) *contextually specified situations* enable the interpretation of the relevant occurrences of remember as relations to situations. For the details of this interpretation, the reader is referred to (Liefke and Werning, 2018: 676–678). The development of this interpretation is left as a project for future work.

is the index of which σ is a (spatial/informational) part (see Sect. 2.2). To capture the role of indices in the interpretation of attitude complements, we hereafter call $\langle w_\sigma, t_\sigma \rangle$ the *(referential) anchor* of these complements (see Liefke and Werning, 2018: 659) and describe sets of situations of the form of the semantic attitude complement in (13) as *anchored attitude complements*.

(13) $[\![\text{remember}]\!]^i = \lambda p \lambda x [\mathit{remember}_i(x, \lambda j \exists \sigma . j \leq \langle w_\sigma, t_\sigma \rangle \wedge p(j))]$

(13) follows the semantics of believe-type verbs from (11) in interpreting attitude verbs as *relations* to the semantic value of their complement. It differs from this interpretation in replacing sets of worlds by sets of *situations* as the semantic values of attitude complements and by restricting these sets to situations that approximate the information of the anchor of the internal situation σ. As a result of this restriction, sets of situations 'encode' information about the world and time of σ. The latter will be relevant for the explanation of DP/CP substitution behavior and (in combination with further assumptions) of Moltmann's objectivization effect.

Note that, in the interpretation of remember from (13), the existential quantifier $\exists\sigma$ scopes *below* (the logical translation of) the attitude verb. This scoping relation reflects the observation that cognitive agents often do not hold attitudes of the form of (1a) *de re* of specific situations or events: reports like (1a) are still true in contexts in which the cognitive agent only remembers the propositional content of the attitude complement (i.e. he/she remembers that there is a past situation/event of which this proposition is true), but is not – or no longer – able to identify the particular situation/event that is described by this complement.

The above interpretation of remember is inspired by the traditional (Barwise/Perry-style) situation-semantic analysis of attitude reports (see Barwise and Etchemendy, 1987; Cooper, 2005; Ginzburg, 2011; cf. Austin, 1970) and by Kratzer's situation-semantic analysis of factive attitude verbs (see Kratzer, 2002, 2006). Barwise and Perry's analysis interprets attitude complements as true Austinian propositions,[11] i.e. as structured objects of the form $\langle s, \sigma \rangle$, where s is a situation, σ is a situation type, and s is correctly classified by σ. Kratzer's analysis interprets factive attitude complements as facts exemplifying the proposition, p, that is expressed by the complement, i.e. as minimal situations (= situations without proper parts) in which p is true.

Sets of situations of the form $\lambda j \exists \sigma [j \leq \langle w_\sigma, t_\sigma \rangle \wedge p(j)]$ (see (13)) code almost the same information as true Austinian propositions or Kratzer-style facts. In particular, in such sets, the role of the referential anchor (which *situates* the complement relative to a particular index) is played by the index that is associated with the situation s (in Austinian propositions) respectively by the index that is associated with the fact that exemplifies p (in Kratzerian facts). The role of the restrictor, p, is played by situation types and by the exemplified proposition, respectively.

Sets of situations of the form $\lambda j \exists \sigma [j \leq \langle w_\sigma, t_\sigma \rangle \wedge p(j)]$ improve upon Kratzer-style facts by enabling the representation of 'unanchored' situations, which is relevant for the interpretation of creation and depiction reports (e.g. (14)). In our semantics, such situations can be represented by sets of isomorphic, i.e. qualitatively identical, situations (see Kratzer, 2002: 667; cf. Fine, 1977: 136). For example, in (14), the depicted (imaginary) situation in which there is a unicorn need not be anchored in a specific world, location, or time: it is well possible for Paul to paint a unicorn without intending to depict *a particular* situation (in some particular possible world,

[11] I thank Robin Cooper and an anonymous reviewer for *Cognitive Structures 2018* for helpful discussions about anchoring and Austinian propositions.

at a specific point in time) that is inhabited by a unicorn.

(14) Paul paints $[_{\mathrm{DP}}$a unicorn$]$.

Sets of situations of the above form improve upon true Austinian propositions by facilitating an account of equivalences of the form displayed in (4): Since Austinian propositions are objects of a different semantic type (viz. $(s \times s)t$) from Russellian propositions (type *st*), they do not straightforwardly enter into entailment relations with the latter. However, such relations are suggested by the cited data (see also (5)–(7) and (10)).

2.2. Situations, contextual specification, and event-dependence

Our previous discussion has made prominent reference to situations. To enable a more realistic modelling of internal situation-arguments,[12] we adopt an informationally partial version of Kratzer-style situations (see Kratzer, 2002, 2006). Situations of this kind are (typically incomplete) collections of information about a specific index $\langle w, t\rangle$ (see Liefke and Werning, 2018: 657–659), i.e. they are *informational approximations* of (particular spatial locations in) indices.

The informational incompleteness of situations induces a partial ordering, $\leq$, on the set of situations: a situation σ_2 *includes* a situation σ_1, i.e. $\sigma_1 \leq \sigma_2$, if σ_2 contains all information of the form ‘*a F*s in *w* at *t*’ that is contained in σ_1, where *a* and *F* are an individual and a property or activity, respectively. This condition requires that the index, $\langle w_{\sigma_2}, t_{\sigma_2}\rangle$, about which σ_2 contains information has the same world-coordinate as the index, $\langle w_{\sigma_1}, t_{\sigma_1}\rangle$, about which σ_1 contains information (s.t. $w_{\sigma_2} = w_{\sigma_1}$), that the time-coordinate, t_{σ_2}, of $\langle w_{\sigma_2}, t_{\sigma_2}\rangle$ includes the time-coordinate, t_{σ_1}, of $\langle w_{\sigma_1}, t_{\sigma_1}\rangle$ (s.t. t_{σ_2} starts before or simultaneously with t_{σ_1} and ends after or simultaneously with t_{σ_1}), and that the location, l_{σ_2}, of $\langle w_{\sigma_2}, t_{\sigma_2}\rangle$ includes the location, l_{σ_1}, of $\langle w_{\sigma_1}, t_{\sigma_1}\rangle$ (s.t. l_{σ_2} maintains or expands the perimeters of l_{σ_1}). Below, we take ‘$\sigma \leq w$’ to assert the inclusion of σ in (the sum of all temporal parts of) the world *w*.

We say that σ_2 *properly includes* σ_1, i.e. $\sigma_1 < \sigma_2$, if σ_2 contains *more* information of the form ‘*a F*s in *w* at *t*’ than is contained in σ_1. We call any situation which includes a situation an *extension* of the included situation, and identify the maximal (consistent) extension of a situation with the (possible) world containing the world-part about which the situation contains information. A situation which is extended by another situation is called a *part* of its extending situation, or an *informational approximation* of its extending situation.

We have suggested above that the witness for $\exists\sigma$ in (13) depends on the external situation *i*. In particular, the contents of different remember*ing* events are anchored in the index-associates of different remember*ed* events. To capture this dependence, we assume that the situation that serves as the internal argument of an attitude report is identified by a contextually given choice function, *f* (see (15)). This function selects a specific situation from the set of situations *S*. The function *f* depends on the external (‘remember*ing*’) situation *i* and is constrained by the particular state or event that is described by the attitude verb (for remember: by the restriction to situations *j* that are located at the world-coordinate, w_i, of the index, $\langle w_i, t_i\rangle$, that is associated

[12]For example, we typically do not remember *all* facts that are true in the relevant situation or event, but only the perceptually or contextually/informationally salient ones (see fn. 10).

with i (i.e. $j \leq w_i$) and that end before (the latest time-point of) the time-coordinate, t_i, of this index (i.e. $j \prec i$) (cf. Stephenson, 2010: 153).

To represent these dependencies, we add a context parameter, C, to the choice function f (see Heusinger, 1997: 74 ff.). This parameter identifies the event described by the attitude verb (for (1a): $\iota e^v[\mathit{remember}'_{@}(e) \wedge \text{AGENT}_{@}(e) = z]$, where @ is a variable for the external situation (above: i) and where z is a free individual-variable that refers to the attitude holder (above: x)). In (15), '$f_C(S)$' then denotes the particular situation that x remembers in i. The resulting interpretation of remember, which will be adopted in the rest of this paper, is given in (15):

(15) $[\![\text{remember}]\!]^i \;=\; \lambda p \lambda x\,[\mathit{remember}_i\,(x, \lambda j\, \exists f.\, j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \wedge p(j))]$

With the presented background on anchoring, contextual specification, and event-dependence in place, we are now in a position to explain DP/CP substitution behavior.

3. Part I: anchors and the substitution problem

We have suggested above that its dependence on a particular remember*ing*-event constrains the choice function f to situations that are located in $w_{@}$ and that end before $t_{@}$. In virtue of these constrains, the interpretation of remember from (15) is equivalent to (16):

(16) $\lambda p \lambda x\,[\mathit{remember}_i\,(x, \lambda j\, \exists f.\, (j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \boldsymbol{\wedge (j \leq w_i \wedge j \prec i)}) \wedge p(j))]$

3.1. Substitution with 'the fact [cp]'

To explain the semantic acceptability of (4b) and its equivalence to the remember-report in (4a), we further consider the situational constraints that are introduced by the interpretation of the DP shell the fact (in (17)). In particular, to capture the common-sense exclusion of counterfactual facts (see Handfield, 2005), we demand that facts be restricted to the actual world (i.e. $j \leq w_{@}$):

(17) $[\![\text{the fact}]\!] \;=\; \lambda p \lambda j\, [\boldsymbol{j \leq w_{@}} \wedge p(j)]$

The 'naturalness' of the truth-conditions of content-readings of (4b) (see (8a)) can then be explained by the observation that the 'constraint-profile' of DPs of the form 'the fact $[_{\text{CP}}\ ]$' (i.e. $\lambda j\,[j \leq w_{@}]$, see (17)) is compatible with the constraint-profile of the verb remember (i.e. $\lambda j\,[j \leq w_{@} \wedge j \prec @]$, see (16)). Specifically, since any pair of situations, $\langle i, j\rangle$, that is such that $j \leq w_i \wedge j \prec i$ is a pair of situations that is such that $j \leq w_i$, the constraint profile of the DP *is already contained in* the constraints on the remember-specific choice function f. This observation explains the intuitive equivalence of (stylized variants[13] of) (4a) and (4b) (see (18)):

(18) $[\![\text{Pat remembers } [_{\text{DP}} \text{the fact } [_{\text{CP}} \text{that } p]]]\!]^i$
$= \mathit{remember}_i\,(pat, \lambda j\, \exists f.\, j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \wedge \boldsymbol{(j \leq w_i \wedge p(j))})$
$\equiv \mathit{remember}_i\,(pat, \lambda j\, \exists f.\, (j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \boldsymbol{\wedge (j \leq w_i \wedge j \prec i)}) \wedge \boldsymbol{(j \leq w_i \wedge p(j))})$
$\equiv \mathit{remember}_i\,(pat, \lambda j\, \exists f.\, (j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \boldsymbol{\wedge (j \leq w_i \wedge j \prec i)}) \wedge p(j))$
$\equiv \mathit{remember}_i\,(pat, \lambda j\, \exists f.\, j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \wedge p(j))$
$= [\![\text{Pat remembers } [_{\text{CP}} \text{that } p]]\!]^i$

[13] These variants replace the CP that Bill bought a sports car by the CP that p.

3.2. Substitution with 'the possibility [cp]'

Our previous considerations have been restricted to the substitution of clausal remember-complements by DPs of the form 'the fact $[_{\text{CP}}\ ]$'. Analogous to these considerations, the substitutivity of the clausal complements of fear with DPs of the form '(the realization of) the possibility $[_{\text{CP}}\ ]$' (see (5)) is explained by constraints on the choice function f that is used in the interpretation of fear, and by the interpretation of the DP shell the possibility: the dependence of f on fear restricts f to situations σ whose indices have the same or a 'later' time-coordinate than the (external) fearing situation, @ (i.e. it restricts f_C to situations j s.t. $@ \preceq j$; see Moltmann, 2003: 129). As a consequence of this restriction, the interpretation of fear from (19) is equivalent to the interpretation in (20):

(19) $[\![\text{fear}]\!]^i \;=\; \lambda p \lambda x\, [fear_i(x, \lambda j\, \exists f.\, j \leq \langle w_{f_C(S)}, t_{f_C(S)} \rangle \wedge p(j))]$

(20) $\equiv\; \lambda p \lambda x\, [fear_i(x, \lambda j\, \exists f.\, (j \leq \langle w_{f_C(S)}, t_{f_C(S)} \rangle \boldsymbol{\wedge i \preceq j}) \wedge p(j))]$

Since one can fear situations that never come true, we assume that the world-coordinate of the index about which σ contains information may be different from the world-coordinate of the index that is associated with the external situation i (i.e. it may be the case that $w_{f_C(S)} \neq w_i$). The possible difference between $w_{f_C(S)}$ and w_i then captures the non-factivity of fear.

We assume that the DP shell the possibility has the interpretation in (21). This interpretation is supported by the restriction of possibilities to future situations or events.

(21) $[\![\text{the possibility}]\!] \;=\; \lambda p \lambda j\, [\boldsymbol{@ \prec j} \wedge p(j)]$

As in the case of remember and 'the fact $[_{\text{CP}}\ ]$', the compatibility of the constraint-profile of fear with the constraint-profile of DPs of the form 'the possibility $[_{\text{CP}}\ ]$' explains the natural truth-conditions of content-readings of (5b). However, since the constraint-profile of the possibility (i.e. $\lambda j\, [@ \prec j]$) is *stricter* than the constraint-profile of fear (i.e. $\lambda j\, [@ \preceq j]$), it only explains the equivalence of 'fear the possibility $[_{\text{CP}}\ ]$'-reports with the result of restricting the complement of clausal fear-reports to future events (see (22)). The future tense of the complement in (5a) (i.e. that Bill <u>will</u> try to hug her) captures this restriction.

(22) $[\![\text{Pat fears } [_{\text{DP}}\text{the possibility } [_{\text{CP}}\text{that } p]]]\!]^i$
$= fear_i\, (pat, \lambda j\, \exists f.\, j \leq \langle w_{f_C(S)}, t_{f_C(S)} \rangle \wedge \boldsymbol{(i \prec j \wedge p(j))})$
$\equiv fear_i\, (pat, \lambda j\, \exists f.\, (j \leq \langle w_{f_C(S)}, t_{f_C(S)} \rangle \boldsymbol{\wedge i \preceq j}) \wedge \boldsymbol{(i \prec j \wedge p(j))})$
$\equiv fear_i\, (pat, \lambda j\, \exists f.\, (j \leq \langle w_{f_C(S)}, t_{f_C(S)} \rangle \boldsymbol{\wedge i \prec j}) \wedge p(j))$
$= [\![\text{Pat fears } [_{\text{CP}}\text{that } p \text{ will happen}]]\!]^i$

Notably, as a result of its particular constraint-profile, fear is also compatible with the constraint-profile of DPs of the form 'the fact $[_{\text{CP}}\ ]$'.[14] This compatibility explains the semantic acceptability of reports like (23) (see (24)):

(23) Pat fears $[_{\text{DP}}$the fact $[_{\text{CP}}$that will Bill buy a sports car$]]$.

[14]On January 22, 2019, a Google search of the string 'fear the fact' yielded 5.310 hits, while a search of the string 'fear the possibility' yielded 10.500 hits.

(24) $[\![$Pat fears $[_{\text{DP}}$the fact $[_{\text{CP}}$that $p]]]\!]^i$
$= \mathit{fear}_i\,(pat, \lambda j\,\exists f.\, j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \wedge \boldsymbol{(j \leq w_i \wedge p(j))})$
$\equiv \mathit{fear}_i\,(pat, \lambda j\,\exists f.\,(j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \boldsymbol{\wedge\, i \preceq j}) \wedge \boldsymbol{(j \leq w_i \wedge p(j))})$
$\equiv \mathit{fear}_i\,(pat, \lambda j\,\exists f.\,(j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \boldsymbol{\wedge (j \leq w_i \wedge i \preceq j)}) \wedge p(j))$
$=$ $[\![$Pat fears $[_{\text{CP}}$that p is happening/will happen at @$]]\!]^i$

The constraint-profiles of the embedding verb and the embedded DP shell can also be used to explain the semantic markedness[15] of the result of combining remember with a DP of the form 'the possibility $[_{\text{CP}}\ ]$' (see (25)): Our account explains this markedness through the incompatibility of the constraint-profiles of the combined expressions (esp. through the incompatibility of $j \prec i$ and $i \prec j$).

(25) $^{??}[\![$Pat remembers $[_{\text{DP}}$the possibility $[_{\text{CP}}$that $p]]]\!]^i$
$= \mathit{remember}_i\,(pat, \lambda j\,\exists f.\, j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \wedge \boldsymbol{(i \prec j \wedge p(j))})$
$\equiv \mathit{remember}_i\,(pat, \lambda j\,\exists f.\,(j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \boldsymbol{\wedge (j \leq w_i \wedge j \prec i)}) \wedge \boldsymbol{(i \prec j \wedge p(j))})$
$\equiv \mathit{remember}_i\,(pat, \lambda j.\,\bot) \;\equiv\; \bot$

We assume that this incompatibility can be resolved by 'adjusting' the interpretations of the DP and the verb to interpretations with compatible constraint-profiles. This adjustment can proceed, e.g., by modifying the interpretation of the DP shell the possibility to an epistemic interpretation (see Kripke, 1980; Edgington, 2004). The treatment of the above-discussed constraints on remember as a factive presupposition (rather than as an integral part of the verb's interpretation, as in (16)) and the cancellation of this presupposition in the described context (see Hazlett, 2012) then enables the desired compatibility. We leave the detailed development of these steps and the exploration of alternative explanations of the acceptability of (25) for another occasion.

3.3. Substitution with 'the proposition [cp]'

To explain the semantic deviance of content-readings of reports like (1b) to (3b), we assume that the DP shell the proposition has the interpretation from (26), where '$\mathit{prop}_j(p)$' is read as 'p is a proposition that is true of j'.

(26) $[\![$the proposition$]\!] \;=\; \lambda p\,\lambda j\,[\mathit{prop}_j(p)]$

The behavior of *prop* is constrained by the following axioms:

(**Ax1**) $\forall p\,\forall j\,[\mathit{prop}_j(p) \leftrightarrow p(j)]$

(**Ax2**) $\neg\exists p\,[\exists q.\,(\forall j.\,p(j) \to q(j)) \wedge (\exists k.\mathit{prop}_k(p) \wedge \neg \mathit{prop}_k(q))]$

Ax1 implements the 'contentfulness' of propositions (i.e. the requirement that all situations that constitute a certain proposition[16] are situations at which (the content of) this proposition is true). **Ax2** ensures the maximal generality of propositions (i.e. that propositions contain *all* situations at which they are true). **Ax1** is motivated by the need to explain the semantic accept-

[15] A Google search on January 22, 2019 yielded 35.300 hits for the string 'remember the fact', but only 2.480 hits for the string 'remember the possibility'.
[16] i.e. that are set-theoretic members of a certain proposition

ability of 'propositional' belief reports like (10b) and to account for the equivalence of the two reports in (10) (see (27)):

(27) $^{\checkmark}[\![\text{Pat believes } [_{\text{CP}}\text{ that } p]]\!]^i$
$= \textit{believe}_i\,(pat, p)$
$\equiv \textit{believe}_i\,(pat, \lambda j.\boldsymbol{prop_j(p)})$ (by **Ax1**)
$= [\![\text{Pat believes } [_{\text{DP}}\text{ the proposition } [_{\text{CP}}\text{ that } p]]]\!]^i$

Ax2 excludes the restriction to situations with particular temporal or spatial properties. As a result, it can be used to explain the semantic deviance of content-readings of reports like (1b):

(28) $^{??}[\![\text{Pat remembers } [_{\text{DP}}\text{ the proposition } [_{\text{CP}}\text{ that } p]]]\!]^i$
$= \textit{remember}_i\,(pat, \lambda j \exists f.\, j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle \wedge \boldsymbol{prop_j(p)})$
$\equiv \textit{remember}_i\,(pat, \lambda j.\, \bot) \quad \equiv \bot$ (by **Ax2**)

The equivalence of the second line in (28) with $\bot$ is based on the observation that $j \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle$ excludes from the remember-complement many situations k which are such that $p(k) \wedge \neg k \leq \langle w_{f_C(S)}, t_{f_C(S)}\rangle$. In Section 4, we will provide an alternative interpretation of (1b) that captures the report's semantically acceptable object-reading (see (8b)).

4. Part II: anchors and the objectivization effect

In Section 1.1, we have assumed that DP complements of attitude reports are interpreted as *objects* of the reported attitude in instances of Moltmann's objectivization effect (s.t. (1b) has the reading in (29), instead of the salient reading in (30)):

(29) Pat remembers $[_{\text{DP}}$ the proposition $[_{\text{CP}}$ that Bill bought a car$]]$.
$\equiv$ Pat's remembering has as its *object* the proposition that Bill bought a sports car

(30) Pat remembers $[_{\text{DP}}$ the fact $[_{\text{CP}}$ that Bill bought a car$]]$.
$\equiv$ a. *salient reading:* Pat's remembering has as its *content* (the fact) that Bill bought a sports car
$\equiv$ b. *alternative reading:* Pat's remembering has as its *object* the fact that Bill bought a sports car

To explain the objectivization effect, we assume that DP/CP-neutral attitude verbs typically have a content-reading, but can be coerced into an object-reading (see Ginzburg, 1995; cf. Pustejovsky, 1993).[17] The content-reading of remember is given in (31a). This reading has exactly the interpretation of remember from (15). From this reading, the coerced reading (see (31b)) is obtained through a partial version of Potts' (2002) nominalization function, $^{\cap}$ (cf. Chierchia, 1984, 1998; Chierchia and Turner, 1988).[18] This function turns the (type *st*) proposition p that is denoted by the DP into an abstract individual (type e). To enable this change of argument-type, the 'propositional' relation *remember* from (15) is coerced into the 'objectual'

[17]Ginzburg (1995) adopts a similar account to capture the complementation behavior of non-factive resolutive verbs (e.g. predict, tell, guess). This account interprets declarative complements of such verbs as propositions, and coerces interrogative complements to denote a fact (see Ginzburg, 1995: 589–590).

[18]$^{\cap}$ is a function of type $(st)e$ which sends propositions (in Potts 2002: sets of worlds; here: sets of situations) to their unique individual correlate. These correlates are abstract individuals that are included in all world-members

relation *remember-obj* (see (31b)).

(31) a. $[\![\text{remember}_{CONT}]\!]^i = \lambda p \lambda x [remember_i(x, \lambda j \exists f.\, j \leq \langle w_{fC(S)}, t_{fC(S)} \rangle \wedge p(j))]$
b. $[\![\text{remember}_{OBJ}]\!]^i = \lambda p \lambda x [remember\text{-}obj_i(x, {}^\cap p)]$

The coerced reading of remember is triggered by an incompatibility between the constraint profiles of the verb remember and the DP (e.g. (1b)), or by an alternative (i.e. 'object'-)reading of the argument (e.g. (9a); see (32a)). The alternative reading gives rise to a mismatch between the type of the content-reading of remember (i.e. $(\boldsymbol{st})(e(st))$; see (31a)) and the type of its complement (type e). It requires a re-interpretation of remember along the lines of (31b). The objectivization effect is then explained through the following stipulation:

(32) a. *When a DP/CP-neutral attitude verb combines with a CP nominalization that is* compatible *with the constraint-profile of the verb (e.g. (4b)), it has as its salient interpretation an interpretation of the form of (31a), and can be assigned an alternative (non-salient) interpretation of the form of (31b);*
b. *When a DP/CP-neutral attitude verb combines with a CP nominalization whose constraint-profile is* in*compatible with the constraint-profile of the verb (see (1b)), it is assigned an interpretation of the form of (31b).*

The above yields the interpretation of stylized variants of (1b) and (25) as (33) and (34), respectively, and predicts the ambiguity of (4b) between the salient interpretation (35a) (see (18)) and the alternative interpretation (35b):

(33) $[\![\text{Pat remembers } [_{\text{DP}} \text{the proposition } [_{\text{CP}} \text{that } p]]]\!]^i$
$= [\![\text{Pat remembers}_{OBJ}\ [_{\text{DP}} \text{the proposition } [_{\text{CP}} \text{that } p]]]\!]^i$
$= remember\text{-}obj_i(pat, {}^\cap(\lambda j.\boldsymbol{prop_j(p)}))$

(34) $[\![\text{Pat remembers } [_{\text{DP}} \text{the possibility } [_{\text{CP}} \text{that } p]]]\!]^i$
$= [\![\text{Pat remembers}_{OBJ}\ [_{\text{DP}} \text{the possibility } [_{\text{CP}} \text{that } p]]]\!]^i$
$= remember\text{-}obj_i(pat, {}^\cap(\lambda j.\boldsymbol{i \prec j \wedge p(j)}))$

(35) $[\![\text{Pat remembers } [_{\text{DP}} \text{the fact } [_{\text{CP}} \text{that } p]]]\!]^i$
a. $[\![\text{Pat remembers}_{CONT}\ [_{\text{DP}} \text{the fact } [_{\text{CP}} \text{that } p]]]\!]^i$
$= remember_i(pat, \lambda j \exists f.\, j \leq \langle w_{fC(S)}, t_{fC(S)} \rangle \wedge p(j))$
$= [\![\text{Pat remembers } [_{\text{CP}} \text{that } p]]\!]^i$
b. $[\![\text{Pat remembers}_{OBJ}\ [_{\text{DP}} \text{the fact } [_{\text{CP}} \text{that } p]]]\!]^i$
$= remember\text{-}obj_i(pat, {}^\cap(\lambda j.\boldsymbol{j \leq w_i \wedge p(j)}))$
$\neq [\![\text{Pat remembers } [_{\text{CP}} \text{that } p]]\!]^i$

of the nominalized proposition. Potts (2002: 57–58) uses such correlates to interpret nominals like the proposal that we destroy Alaska's priceless wilderness. In Potts (2002), this DP is interpreted as $\iota x[proposal(x) \wedge x = {}^\cap(\lambda i.\, destroy_i(we, alaska))]$.

Note that the interpretations from (33) to (35) preserve the intuitive difference between remembering a proposition, remembering a fact (on the object-reading), and remembering a possibility. As desired, these interpretations support the intuitive *in*validity of the substitution in (1) (which exemplifies Moltmann's objectivization effect) and the validity of the inferences from (4a) and (5a) to the salient readings of (4b) (see (8a)) and (5b). At the same time, they explain the possible invalidity of the inference from (4a) to (4b) (namely, on the alternative reading of (4b); see (9a)).

This completes our account of the objectivization effect. We close this paper by presenting some challenges for the proposed account that have been mentioned in the literature and by sketching initial answers to these challenges. The detailed development of these answers is left as a project for future work.

5. Objections and replies

Seeming challenges to our account include the observation that some DP/CP-neutral factive verbs (e.g. see, hear) do not allow complements of the form 'the fact $[_{\text{CP}}\ ]$' (see Moltmann, 2015), that some attitude verbs (e.g. predict, require) only allow a substitution by descriptions of entities other than propositions, facts, or possibilities (see Asher, 1993; Elliott, 2016), and that close relatives of our account (e.g. Asher, 1993; King, 2002, 2007; Parsons, 1993) are unable to explain the possibility of simultaneously quantifying over the object DPs of different attitude verbs. The last-mentioned problem is sometimes called *the problem of doxastic shift* (see Moffett, 2003). We discuss each of these challenges below:

5.1. Challenge 1: non-fact factive complements

Our account interprets factive verbs (e.g. remember) as verbs that restrict the choice function f to situations that are located in the world $w_@$, and interprets DPs of the form 'the fact $[_{\text{CP}}\ p]$' as sets of informational approximations of $w_@$ in which p is true (see Sect. 3.1). These interpretations are challenged by the observation that some factive verbs (esp. perception verbs like see[19] and hear) resist the truth-preserving substitution of their CP complement by a DP of the form 'the fact $[_{\text{CP}}\ ]$' (see (3a), copied in (36a); cf. (37)). Example sentence (37) is due to Moltmann (2015):

(36) a. Pat sees $[_{\text{CP}}$ that Bill is waiting for her$]$.
b. #Pat sees $[_{\text{DP}}$ the fact $[_{\text{CP}}$ that Bill is waiting for her$]]$.

(37) a. Bill heard $[_{\text{CP}}$ that Mary was next door$]$.
b. #Bill heard $[_{\text{DP}}$ the fact $[_{\text{CP}}$ that Mary was next door$]]$.

We propose to explain the above substitution-resistance through the selectional restrictions of the matrix factive verb. This proposal is based on the observation that the described substitution-

[19]The factivity of see is evidenced by the observation that the truth-at-@ of the visual perception report (36a) entails the truth-at-@ of the report's CP complement. It is further evidenced by the observation that the factive presupposition of see is preserved under negation, such that (‡a) still entails (‡b):

(‡) a. Pat does not see $[_{\text{CP}}$ that Bill is waiting for Pat$]$.
$\Rightarrow$ b. Bill is waiting for Pat.

resistance is restricted to the complements of verbs whose selectional restrictions exclude abstract object-denoting complements (for see) or non-physical object-denoting complements (for hear). This observation suggests the following addition to our account of DP/CP substitution behavior from Section 3.1:

(38) a. *In the complements of factive verbs whose selectional restrictions* admit *abstract object-denoting complements, a CP allows for the truth-preserving substitution by a DP of the form 'the fact* $[_{\text{CP}}\ ]$*';*

b. *In the complements of factive verbs whose selectional restrictions* exclude *abstract object-denoting complements, this substitution is not licensed.*

5.2. Challenge 2: the need for other content DPs

The presented account of the substitution problem is further challenged by the observation that some DP/CP-neutral attitude verbs (e.g. predict, overhear) restrict the substitution of their CP complement to DPs like 'the result/outcome $[_{\text{CP}}\ ]$' or 'the rumor/gossip $[_{\text{CP}}\ ]$' (see Elliott, 2016; Moltmann, 2015; cf. Asher, 1993).

(39) a. Pat predicted $[_{\text{CP}}$ that Bill would be disappointed$]$.

b. $^{??}$Pat predicted $[_{\text{DP}}$ the fact $[_{\text{CP}}$ that Bill would be disappointed$]]$.

c. $^{\checkmark}$Pat predicted $[_{\text{DP}}$ the result/the outcome $[_{\text{CP}}$ that Bill would be disappointed$]]$.

(40) a. Mary overheard $[_{\text{CP}}$ that Bill had a crush on Pat$]$.

b. $^{\#}$Mary overheard $[_{\text{DP}}$ the fact/the possibility $[_{\text{CP}}$ that Bill had a crush on Pat$]]$.

c. $^{\checkmark}$Mary overheard $[_{\text{DP}}$ the rumor/the gossip $[_{\text{CP}}$ that Bill had a crush on Pat$]]$.

Since some of these verbs and DPs (e.g. 'overhear', 'the rumor $[_{\text{CP}}\ ]$') intuitively do not show the kind of temporal or 'world-specific' properties that have been used to explain the substitutivity with DPs of the form 'the fact $[_{\text{CP}}\ ]$' or 'the possibility $[_{\text{CP}}\ ]$', they pose a potential challenge to our account.

We propose to solve this challenge by exploiting other relevant semantic properties of the above verbs. In particular, we claim that predict and overhear are still sufficiently systematic to have a 'verb-relevant' constraint-profile. The associated interpretations of the DP shells the outcome and the rumor are given in (41) and (42), respectively, where '$said_j(p)$' := 'p is uttered at j', '$action_{@}(\sigma)$' := 'σ is an action or event that takes place in @', and '$cause_j(p,\sigma)$' := 'σ brings it about that p is true at j'. The latter implies that σ temporally precedes j, i.e. $\sigma \prec j$.

(41) $[\![\text{the outcome}]\!] = \lambda p \lambda j\, [p(j) \wedge (\exists \sigma^{s}.\, action_{@}(\sigma) \wedge cause_j(p,\sigma))]$

(42) $[\![\text{the rumor}]\!] = \lambda p \lambda j\, [said_j(p)]$

The above interpretations capture the resultative factive nature of outcomes and the verbal non-factive nature of rumors.

We assume that the choice function for predict is constrained by the condition $\lambda j\, [@ \prec j]$ (i.e. predictions are restricted to possible future situations or events) and that overhear has the interpretation from (45). As a result of its constraint, the interpretation of predict from (43) is equivalent to (44):

$$\text{(43)} \quad [\![\text{predict}]\!]^i = \lambda p \lambda x [predict_i(x, \lambda j \exists f. j \leq \langle w_{fc(S)}, t_{fc(S)} \rangle \wedge p(j))]$$

$$\text{(44)} \quad \equiv \lambda p \lambda x [predict_i(x, \lambda j \exists f. (j \leq \langle w_{fc(S)}, t_{fc(S)} \rangle \boldsymbol{\wedge i \prec j}) \wedge p(j))]$$

$$\text{(45)} \quad [\![\text{overhear}]\!]^i = \lambda p \lambda x [overhear_i(x, \lambda j \exists f. j \leq \langle w_{fc(S)}, t_{fc(S)} \rangle \wedge p(j))]$$

$$\equiv \lambda p \lambda x [overhear_i(x, \lambda j \exists f. (j \leq \langle w_{fc(S)}, t_{fc(S)} \rangle \boldsymbol{\wedge} \\ \boldsymbol{(\exists y. \textit{is-a-sound-indicative-of}_j(y, p))}) \wedge p(j))]$$

The above interpretations explain the semantic acceptability (or 'naturalness') of (39c) and (40c), and the semantic deviance of (40b). Notably, the constraint-profile of predict also explains the possibility of combining predict with 'the possibility $[_{\text{CP}}\ ]$'. This is due to the identity of the constraint-profiles of predict (see (44)) and the possibility (i.e. $\lambda j [@ \prec j]$, see (21)).

5.3. Challenge 3: the problem of doxastic shift

Our account of the DP/CP substitution behavior uses a formal version of Moltmann's Unique Determination Property (UDP) of clausal complements (see Moltmann, 2013: 129). This Property assumes that the semantic value of a CP varies with the attitude verb that takes this CP as its complement. Depending on its embedding attitude verb, a CP will thus denote a *fact* (in the complement of past-oriented factive verbs like remember; cf. Parsons, 1993; Kiparsky and Kiparsky, 1970), a *possibility* (in the complement of negative future-oriented verbs like fear), a *proposition* (in the complement of mental action verbs like believe), or some other proposition-like object. UDP is further supported by different versions of the *ambiguity thesis* about CPs. This thesis asserts a semantic ambiguity (or polysemy) of CPs between propositions, facts, possibilities, and other proposition-like objects. Different versions of the ambiguity thesis have been proposed by Asher (1993), Parsons (1993), Moffett (2003), and King (2002, 2007).

For many ambiguity accounts, the semantic variation of CPs with their embedding verb gives rise to the problem of *doxastic shift* (see Moffett, 2003). This problem describes the inability of these accounts to explain the possibility of simultaneously quantifying over the objects of different attitudes[20] (see (46a–c); cf. Harman, 2002; King, 2002: 355) and of embedding a CP under the result of coordinating two attitude verbs (see (47)). In particular, on these accounts, there are no objects that serve both as the content of Pat's fearing and of Mary's believing (i.e. $\neg \exists p. \exists i. fear_i(pat, p) \wedge believe_i(mary, p)$): any object (here: a possibility) that would qualify as a suitable content of Pat's fearing would disqualify as a content of Mary's believing. Inversely, any object (here: a proposition) that would qualify as a suitable content of Mary's believing would disqualify as a content of Pat's fearing.

(46) a. Pat fears what Mary believes.
b. Pat fears something/everything (that) Mary believes.
c. Pat fears the proposition that Mary believes.

(47) Mary believes, and Pat fears, that Bill will try to hug Pat.

[20] Moltmann (2015: 9) describes this possibility as *cross-attitudinal quantification*.

Our account avoids the above problem by distinguishing the semantic contribution of an attitudinally embedded DP (or CP) (in the existential case of (46b): the interpretation of the quantifier something, i.e. $(\exists)p$) from the interpretation of this DP as the argument of the different attitude verbs (i.e. $\lambda j \exists f.\, j \leq \langle w_{fC(S)}, t_{fC(S)}\rangle \wedge p(j)$ (as the argument of *fear*) and $\lambda j.\, prop_j(p)$ (as the argument of believe)). The identification of the semantic contribution of the DP something to the interpretation of the complements of fear and believe enables quantification over the (propositional) content that is common to propositions and possibilities (or facts) (see (48)):

(48) $[\![$Pat fears $[_{\text{DP}}$something Mary believes$]]\!]^i$
$= \exists p\,[fear_i\,(pat, \lambda j \exists f.\, j \leq \langle w_{fC(S)}, t_{fC(S)}\rangle \wedge p(j)) \wedge believe_i(mary, p)]$
$\equiv \exists p\,[fear_i\,(pat, \lambda j \exists f.\, j \leq \langle w_{fC(S)}, t_{fC(S)}\rangle \wedge p(j)) \wedge believe_i(mary, \lambda k.prop_k(p))]$
$=$ one of the possibilities that Pat fears has the same content as one of the propositions that Mary believes

Since abstract object DPs always make the same semantic contribution, our account also gives a suitable interpretation of (46c) (in (49)):

(49) Pat's fearing has as its *object* the proposition that is the *content* of Mary's believing
$= \exists p.\, prop_i(p) \wedge [fear\text{-}\boldsymbol{obj}_i(pat, {}^{\cap}(\boldsymbol{\lambda j.prop_j(p)})) \wedge believe_i(mary, \boldsymbol{\lambda j.prop_j(p)})]$

The incompatibility of the contraint-profiles of proposition and fear excludes the interpretation of 'content/content'-readings of the above report (see (50); cf. (28)):

(50) #Pat's fearing has as its *content* the proposition that is (also) the content of Mary's believing
$= \exists p.\, prop_i(p) \wedge [fear_i(pat, \boldsymbol{\lambda j \exists f.\, j \leq \langle w_{fc(S)}, t_{fc(S)}\rangle \wedge prop_j(p)}) \wedge believe_i(mary, \boldsymbol{\lambda j.prop_j(p)})]$
$\equiv \exists p.\, prop_i(p) \wedge [fear_i(pat, \boldsymbol{\lambda j.} \bot) \wedge believe_i(mary, \boldsymbol{\lambda j.prop_j(p)})]$
$=$ Pat's fearing has a *different* content from Mary's believing

6. Outlook

In this paper, we have developed a uniform account of the different phenomena that surround the substitution of CP complements by DPs of the form 'the proposition/fact/possibility $[_{\text{CP}}\ ]$'. These phenomena include the observation that different DP/CP-neutral attitude verbs restrict the substitution of their CP complement to different DPs and that – depending on the identity of the substituted DP – the substitution of a CP by a DP may effect a semantic shift (i.e. objectivization) of the semantic attitude complement. Our investigation of this shift has identified a new (sub-)class of instances of Moltmann's *objectivization effect* (see (9b) $\Rightarrow$ (9a)).

This paper has taken as its point of departure the non-substitutivity of CPs with DPs of the form 'the proposition $[_{\text{CP}}\ ]$' (i.e. Prior's *substitution problem*). However, our considerations from this paper have shown that the substitution of CP complements with DPs other than 'the proposition $[_{\text{CP}}\ ]$', e.g., with 'the fact $[_{\text{CP}}\ ]$', 'the possibility $[_{\text{CP}}\ ]$', or 'the rumor $[_{\text{CP}}\ ]$', is fairly well-attested: even verbs (e.g. believe, prove) which are commonly predicted to select for DPs of the form 'the proposition $[_{\text{CP}}\ ]$' (see (10)) much more frequently combine with other CP nominalizations. Thus, on January 18, 2019, a Google search of the string 'believe the proposition that’ only yielded 593 hits, while a search of the strings ‘believe the fact that’ and ‘believe the rumo(u)r that’ yielded 19.400 hits and 162.300 hits, respectively.

We take these findings to suggest that the historical focus on Prior’s substitution problem has distracted research on DP/CP substitution from more productive linguistic phenomena (e.g. the above successful substitutions). We leave the experimental and/or corpus-linguistic study of these phenomena as a project for future research.

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The pragmatics of semantic change: Modeling the progressive-to-imperfective shift[1]

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Abstract. We implement a computational model of the cyclic progressive-to-imperfective shift, wherein languages with a single imperfective marker grammaticalize new progressive markers that ultimately broaden in interpretation and displace the older imperfective. While Deo (2015) offers a model of this process within the framework of evolutionary game theory, her model ultimately ignores the semantics she takes such care to construct. Our model, conceived within the Rational Speech Act modeling framework, offers a different perspective, operating directly over the utterance semantics. We show how semantic change may be a function of changes in utterance cost—a reflection of morphological complexity or frequency-of-use—as it relates to pragmatic reasoning. Counter to claims that grammaticalization is a process of conventionalization of implicature, our model holds the denotations of aspectual markers static; what changes is how we reason about their use given their changing costs.

Keywords: imperfective aspect, diachronic change, pragmatics, Rational Speech Act models.

1. Introduction

Traditional distinctions between aspectual categories contrast the imperfective with the perfective. Whereas perfective meaning is primarily characterized in terms of temporal boundedness, imperfective meaning is unbounded. Within the imperfective meaning space, several further distinctions may be drawn, though the names (and boundaries) of these categories often vary throughout the literature. Members of the imperfective meaning space include habitual, progressive, and continuous interpretations. Despite receiving different labels, their meanings often overlap.

Languages with two imperfective exponents divide this imperfective space in various ways. We follow Deo (2015) in calling one exponent IMPF, for imperfective, and the other PROG, for progressive. Broadly construed, IMPF is closely associated with what Deo calls "characterizing" readings, where the predicate is said to hold as a matter of habit, but not necessarily *right now* or at the relevant reference time. By contrast, PROG is most closely associated with events in progress: the predicate holds at the reference time, and no claims are made about the predicate holding beyond that point.

This situation is what we see in Present-Day English: the two interpretations arise in the contrast between the simple present tense, (1a), and the progressive *-ing* form of the verb, (1b).

(1) a. John eats cake.
    b. John is eating cake.

In (1a), the most likely reading is that John eats cake on occasion; he has not cut it out of his diet. In (1b), the most likely reading is that John is eating cake at (or very near—he might be

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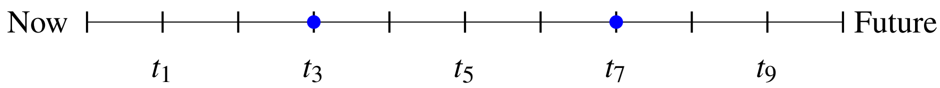

Figure 1: Visual representation of a scenario that could verify a characterizing interpretation. Dots represent indices at which the relevant predicate *P* holds. In this scenario, the predicate holds intermittently over a longer time span.

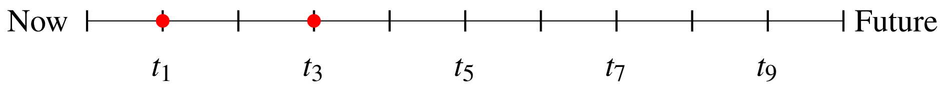

Figure 2: Visual representation of a scenario that could verify an event-in-progress interpretation. Dots represent indices at which the relevant predicate *P* holds. In this scenario, the predicate holds at times close to *now*.

between bites) the time of the utterance.

Figures 1 and 2 offer a way of visualizing the sorts of abstract scenarios that could verify each interpretation. The colored dots correspond to a time index at which some predicate holds. Lower time indices are temporally closer to the reference time (e.g., to *now*), and higher indices are farther in the future. The red scenario in Figure 2, with its events more closely clustered around the reference point, satisfies an event-in-progress interpretation wherein the predicate holds at or near the reference time. By contrast, the blue scenario in Figure 1 spreads its events more consistently over a longer time interval, thereby verifying a characterizing reading that asks after whether the predicate holds more generally.

In Present-Day English, the contrast between simple present and present progressive maps fairly cleanly onto the split between characterizing and event-in-progress interpretations; each form is best suited to a particular interpretation. The simple present is used to describe characterizing scenarios like the blue series in Figure 1. By contrast, the present progressive cannot generally be used to describe scenarios like in Figure 1. Instead, it is used to describe event-in-progress scenarios like the red series in Figure 2, which the simple present cannot be used to describe.

Though (1a) and (1b) have clear interpretive differences in Present-Day English, the meanings associated with these forms are not stable over time. In particular, English exemplifies part of a cross-linguistic trend in which IMPF exponents interact with and ultimately are displaced by PROG exponents. As part of this diachronic trend, IMPF begins as the dominant exponent, being used with both event-in-progress and characterizing readings. In these early stages, PROG optionally—and narrowly—gets used to describe events in progress. Over time, PROG's meaning broadens to capture characterizing scenarios, while IMPF loses the ability to describe events in progress. We see this pattern in the historical development of English.

In Middle English, the simple present was used with both characterizing and event-in-progress readings, as seen in (2a) and (2b).

(2) a. Now hier now ther, now to now fro,
Now up now down, this world **goth** so
(Gower, *Confessio Amantis* 569-570, via Visser, 1966)

b. Now my penne, allas, with which I **write**, **quaketh** for drede
(Chaucer, *Troilus and Criseyde* IV.13-14, via Visser, 1966)

While both (2a) and (2b) use the same simple present verb form, (2a) refers to a general property of how the world "goes," whereas (2b) refers to specific events of writing and quaking taking place at the time of utterance. In contrast to Present-Day English, these differences in interpretation are not linked to a difference in form. The dominant exponent in the Middle English period was IMPF (i.e., the simple present); PROG (i.e., the present progressive) had not yet been innovated or grammaticalized. As a result, both characterizing and event-in-progress interpretations could be communicated via the same general-purpose IMPF exponent. Returning to the abstract scenarios from Figures 1 and 2, in Middle English the simple present could be used to describe both the red and the blue scenarios.

By the Early Modern period of English, the present progressive did serve as a productive grammatical device. However, the situation still contrasted with that of Present-Day English because the simple present could be used to describe a wider range of scenarios. In particular, both IMPF, (3a), and PROG, (3b), could be used to describe events in progress.

(3) a. What **do** you **read**, my lord?
(Shakespeare, *Hamlet* II.2.191)
b. Now my spirit **is going**; I can no more.
(Shakespeare, *Antony and Cleopatra* IV.15.58-59)

While both of the examples in (3) describe particular events in progress, the verb forms used nonetheless differ. Both the simple present and present progressive could be used, that is, to describe a scenario like the red series in Figure 2. However, as in Present-Day English, only the simple present could be used to describe the blue series in Figure 1.

The various stages of English are summarized in Table 1. Starting in the Middle period, English had a multi-purpose IMPF that could describe both event-in-progress and characterizing scenarios. In the period between Middle and Early Modern English, the present progressive (PROG) was innovated. The simple present (IMPF) retained both event-in-progress and characterizing interpretations in Early Modern English, as it had in Middle English, and the present progressive came to serve as an additional exponent specialized for event-in-progress interpretations only. By Present-Day English, the interpretations associated with PROG have not changed (PROG can only describe events in progress), but the interpretations associated with IMPF have narrowed: IMPF can only be used to describe characterizing scenarios.

In some languages (though not English, at least not yet), the progression continues such that IMPF gets displaced even further, with PROG's usages expanding to include characterizing interpretations. We find this pattern in Tigre, a Semitic language spoken in Eritrea. In (4a) and (4b), the verb appears in the progressive, which is formed periphrastically from the imperfective with an additional tense auxiliary.

(4) a. ʔana nəʔus ʔət ʔana kəldol ʔət bet məhro **ʔəgayas ʔalko**
I small while being I every time to school **go-IMPF be-PST.1SG**
"When I was young, I used to go to school every day." (Raz, 1983)

Language	Exponent	Scenario: Event-In-Progress	Scenario: Characterizing
Middle English	PROG		
	IMPF	✓	✓
Early Modern English	PROG	✓	
	IMPF	✓	✓
Present-Day English	PROG	✓	
	IMPF		✓
Present-Day Tigre	PROG	✓	✓
	IMPF		✓

Table 1: Summary of the interpretations associated with the present progressive (PROG) and simple present (IMPF) at various stages in the history of English, as well as in Present-Day Tigre.

b. ħəna həda:y **nətfarrar hallena**
we wedding **go out-IMPF be-PRES.1PL**
"We are going out to the wedding." (Raz, 1983)

In (4b), PROG receives an event-in-progress reading: the speaker is in the process of going to the wedding at the time of utterance. However, crucially, in (4a), the progressive is used to describe a characterizing scenario: going to school was a regular occurrence in the speaker's childhood. Given its ability to describe characterizing scenarios, we see that the interpretations associated with PROG have broadened. Returning once again to the scenarios in Figures 1 and 2, in Tigre PROG is still the only exponent that can describe an event-in-progress scenario like the red series. In contrast to English, however, both IMPF and PROG can describe the blue characterizing scenario.

This progression of change, with PROG emerging, broadening, and ultimately displacing IMPF, is said to constitute a grammaticalization pathway, whereby a progressive exponent takes on the role of an imperfective exponent. It should be noted that this pathway only follows one direction: progressive takes on the role of imperfective, but not vice-versa. This particular pathway resembles a Jespersen cycle (van der Auwera, 2009), with PROG eventually replacing IMPF and then the progressive-to-imperfective change beginning anew. In other words, the logical conclusion of the broadening of PROG's associated interpretations would have PROG entirely displace IMPF. At that point, the language would again have a single, multi-purpose exponent for expressing both characterizing and event-in-progress scenarios, and so the change could begin once again with the innovation of an event-in-progress-only PROG$'$.

The question that immediately arises is what drives the progressive-to-imperfective shift such that we commonly find it cross-linguistically. The current paper offers an information-theoretic answer to this question that we cash out in terms of pragmatic reasoning about shifting utterance costs. Our proposal gets articulated as a computational cognitive model of language understanding, formalized within the Rational Speech Act modeling framework (Frank and

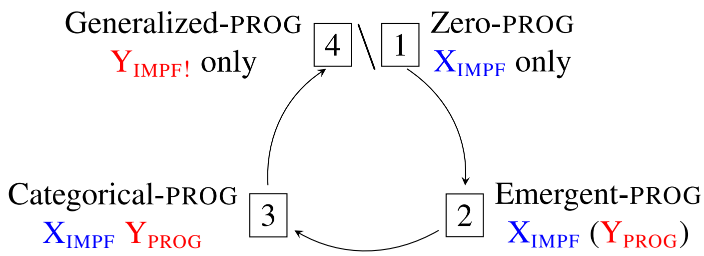

Figure 3: Visual representation of the four stages assumed in Deo's (2015) account of the progressive-to-imperfective shift. In stages 1 and 4, a single exponent describes both characterizing and event-in-progress scenarios. In stage 2, the language innovates a progressive exponent that optionally gets used for event-in-progress scenarios. In stage 3, both exponents are fully productive and each gets used to describe a single scenario type.

Goodman, 2012; Goodman and Frank, 2016). Drawing our inspiration from the semantic proposal and game-theoretic model of Deo (2015), we show how both production behavior (i.e., frequency of use) and comprehension behavior (i.e., the interpretations available) can change as a function of utterance costs. Section 2 reviews the relevant background from Deo (2015). Section 3 takes a closer look at the connection between form and meaning in the context of diachronic change. In Section 4, we present our computational model of the progressive-to-imperfective shift, and then explore our findings in Section 5. Section 6 considers the implications of our findings for the progressive-to-imperfective shift and theories of semantic change more broadly. Section 7 concludes.

2. Background: Deo's stages

Deo (2015) assumes that the progressive-to-imperfective shift occurs in four discrete stages, with distinct transitions between the stages; these stages are summarized in Figure 3. The shift begins in the *zero*-PROG stage, as in Middle English, where the language has only an IMPF exponent. Context or syntactic devices such as adverbials serve to distinguish the various readings of IMPF. One of these devices may eventually be recruited as a grammatical PROG exponent, at which point the language transitions into the *emergent*-PROG stage. Often, these new PROG exponents originate in locative constructions, as well as in verbs having a meaning like *standing* (Bybee and Dahl, 1989; Bybee et al., 1994). For instance, the Yagari progressive prefix *no-* has its origins in a verb *yano* 'to exist', used in locative and existential constructions (Renck, 1975). More broadly, in the *emergent*-PROG stage, IMPF remains the dominant aspectual device, but PROG may optionally be used to describe events in progress; Early Modern English existed in this stage.

The use of PROG to signal events in progress eventually becomes conventionalized, and the language moves into the *categorical*-PROG stage. In this stage, both exponents are obligatory and they are used to express different interpretations: IMPF receives a characterizing interpretation, while PROG receives an event-in-progress interpretation—this is the situation in Present-Day English. Deo suggests that the transition from the *emergent*- to *categorical*-PROG stage is driven by the literal meanings of the two forms. In her semantics, to which we turn presently, PROG is semantically stronger than IMPF. This asymmetry in the entailment relations results in a scalar implicature, where the use of the semantically weaker IMPF implies that the semantically stronger PROG does not hold. In other words, by using IMPF, a speaker might imply that her utterance should not receive an event-in-progress interpretation, since PROG is specialized for event-in-progress uses but PROG was not used. Deo suggests that the conventionalization of this implicature results in the transition to a *categorical*-PROG stage.

Finally, the language moves into the *generalized*-PROG stage, wherein the IMPF form falls out of use entirely, leaving the language with the PROG exponent for expressing both characterizing and event-in-progress meaning. Note that the *generalized*-PROG stage is formally equivalent to the *zero*-PROG stage, with the erstwhile PROG now serving as the IMPF exponent. Deo suggests that the transition from *categorical*- to *generalized*-PROG might be due to a learner's bias toward simpler grammars: as PROG's frequency of use increases, a learner might be more likely to incorrectly generalize PROG's interpretations to include characterizing ones as well as events in progress. At a certain point, the learner encounters IMPF so infrequently in the input that it no longer serves as a viable device.

2.1. Deo's semantics

The key transition for Deo is the one between the *emergent*- and the *categorical*-PROG stages (stages 2 and 3 in Figure 3). As mentioned above, Deo assumes that this transition is driven by scalar implicature. To see how, we must consider Deo's semantics.

For Deo (2009, 2015), both IMPF and PROG feature universal quantification over a partitioned time interval. IMPF and PROG differ in that the partitioned interval over which IMPF quantifies is a (possibly improper) superinterval j of the reference interval i, a contextually-determined interval of time relevant to the evaluation of the utterance. The superinterval over which IMPF quantifies is constrained to have the reference interval as its initial portion ($i \subseteq_{ini} j$); PROG quantifies over the reference interval itself. More precisely, both IMPF and PROG quantify over regular partitions of the relevant intervals.

The semantic difference between IMPF and PROG is given in (5). In (5a), $\mathscr{R}_j^c$ is a regular contextual partition of the superinterval j; in (5b), $\mathscr{R}_i^c$ is a regular contextual partition of the reference interval i. $\text{COIN}(P,k,w)$ holds when P is true at some partition cell k (i.e., a time index) in w. The smaller the partitioned interval, the smaller the partitions and the closer each individual partition is to *now* (i.e., the reference time). As a result, as the interval shrinks in size, the predicate must hold at times closer to *now* in order to satisfy the COIN relation. The larger the partitioned interval, the farther each partition cell is from *now* and the farther apart each cell-overlapping event may be.

(5) a. $[\![\text{IMPF}]\!] = \lambda P \lambda i \lambda w. \exists j [i \subseteq_{ini} j \wedge \forall k [k \in \mathscr{R}_j^c \rightarrow \text{COIN}(P,k,w)]]$
 b. $[\![\text{PROG}]\!] = \lambda P \lambda i \lambda w. \forall k [k \in \mathscr{R}_i^c \rightarrow \text{COIN}(P,k,w)]]$

Since both intervals start at the reference time, smaller intervals correspond to event-in-progress readings, as the predicate must hold at times close to *now*; larger intervals correspond to characterizing readings, as the predicate may hold farther into the future and be more sporadically distributed over time. See Figure 4 for a visual representation of these intervals and interpretations. In the figure, the reference interval i is represented by the red partitioned box. Here, PROG holds of the red scenario, since one event (i.e., dot) occurs within each cell of the partition. By contrast, PROG does not hold of the blue scenario, since no blue dot occurs within

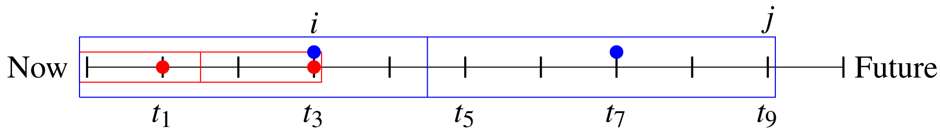

Figure 4: Visual representation of PROG (red) and IMPF (blue) verifying scenarios, where dots represent indices at which the relevant predicate P holds. The red box represents the reference interval i, and the blue box represents a superinterval j.

the leftmost cell in the partition of i. However, IMPF does hold of the blue scenario, since we can find a larger interval j (one possible choice of j is indicated here by the blue partitioned box) for which each cell contains a blue event. Trivially, IMPF also holds of the red scenario, since we could choose j in this case to be exactly the reference interval i. In other words, whenever PROG holds, IMPF also holds because the superinterval relevant to IMPF can always be the reference interval satisfying PROG.

In a system where both PROG and IMPF are active, given that PROG describes a narrower set of scenarios than IMPF, the use of PROG entails IMPF. This asymmetry leads to a run-of-the-mill scalar implicature whereby the use of IMPF implies that PROG does not hold (a speaker would use the stronger PROG if it were true), which suggests that the predicate fails to hold for the contextually-salient reference interval (i.e., the interval of which PROG would have been true). In other words, the use of IMPF rules out the narrower set of interpretations PROG wold have delivered, which eliminates event-in-progress readings for IMPF. Conversely, the use of PROG suggests that the predicate does not hold *beyond* the reference interval, ruling out characterizing and habitual readings that extend into the future beyond the reference interval. By conventionalizing the implicature, speakers arrive at the *categorical*-PROG stage where IMPF and PROG are used to signal characterizing and event-in-progress scenarios, respectively.

2.2. Deo's model

To model the progressive-to-imperfective shift, Deo treats the discrete stages in Figure 3 as pairs of speaker-hearer strategies—in other words, culturally-transmitted conventions—for communicating about the world. A speaker must either address a phenomenal (roughly, event-in-progress) or a structural (roughly, characterizing) inquiry using either PROG or IMPF to do so. In principle, both forms are capable of addressing both types of inquiry; at issue are the conventions of use and interpretation: whether a speaker uses PROG or IMPF to address phenomenal or structural inquiries, and whether a hearer interprets PROG or IMPF as addressing phenomenal or structural inquiries. Conventions are successful to the extent that they lead to successful communication (i.e., to the extent that they align across speakers and listeners), and their success makes the convention more appealing (and more prevalent) in the population. Using the tools of evolutionary game theory, Deo models the dynamic system in which these conventions are selected, propagated, and changed over time. See also Yanovich (2017) for a proposed refinement to Deo's model operating according to these same principles.

While Deo's evolutionary model does well to capture her stages of the progressive-to-imperfective shift, it does so without making use of her proposed semantics. In place of the semantics we have linguistic conventions, and the connections from one to the other are left unsaid. It remains to be seen whether a model that operates directly over the semantics of PROG and IMPF can successfully capture changes in conventions such that PROG's usage expands to cover the cases previously handled by IMPF.

3. Form and meaning

As we search for inspiration for our own model of the diachronic shift in aspectual markers, here we take notice of another change concomitant with the changes in meaning in the progressive-to-imperfective shift: changes in form. Grammaticalization processes usually involve the loss of phonetic and morphological material, as well as a change in syntactic category. As a construction progresses along a grammaticalization pathway, its form changes in tandem with its meaning. The pathway of forms is often referred to as a *cline*. For instance, Hopper and Traugott (2003) propose the following cline for verbal grammaticalization:

(6) Full verb > Vector verb > Auxiliary > Clitic > Affix

Cross-linguistic evidence suggests that when a verb form undergoes grammaticalization, it tends to follow the pathway above. The English verb *have* is an example of this change, starting as a fully lexical verb, then finding use as an auxiliary, and eventually further changing to a clitic as in *we've* (Hopper and Traugott, 2003).

Generalizing further, clines follow the schema in (7), though individual cases of grammaticalization often skip some stages along the chain:

(7) Content item > Grammatical word > Clitic > Inflectional affix > (Zero)

As change progresses, the item undergoing the change loses both syntactic independence and phonological and morphological weight. A critical component of a cline is its unidirectionality: we overwhelmingly see forms lose weight, but rarely do they gain it (Hopper and Traugott, 2003; Lehmann, 2015; see also Börjars and Vincent, 2011, for a discussion of the status of directionality in grammaticalization theory).

Imperfective and progressive forms follow the same general trend. Early progressive forms are often morphosyntactically heavier than imperfective forms, and lose material as they grammaticalize. Turkish provides evidence of this pattern: the Old Turkic lexical verb *yor* 'to walk' first became an auxiliary verb with progressive meaning, and then became the progressive suffix *-iyor* in Modern Standard Turkish (Clauson, 1972; Lewis, 1967; Erdal, 2004). In other words, as PROG took hold in Turkish, its form slimmed down.

If progessive forms are younger than imperfective forms and start heavier than imperfective forms, we should expect that progressive exponents are morphosyntactically heavier than imperfective exponents synchronically. This, in fact, bears out. Bybee and Dahl (1989) report that, using data from Dahl's (1985) crosslinguistic survey of tense and aspect systems, imperfective forms are morphologically reduced compared to progressive forms. In that survey, eighteen of nineteen progressive exponents are periphrastic (i.e., heavy and prominent), while seven of seven imperfective exponents are bound morphemes (i.e., light and less prominent).

The progressive-to-imperfective shift, then, is not merely a process of meaning change. It is also a process of morphological and phonological change. As the progressive exponent grammaticalizes, it usually loses phonological material and syntactic independence. In languages with distinct progressive and imperfective exponents, the progressive is often phonologically and syntactically heavier. This morphological asymmetry is true in the case of English, where the progressive involves both a tensed form of the auxiliary *be* and a verbal suffix, while the present marker is a simple suffix. We propose that when it comes to modeling the progressive-to-imperfective shift, one should take these morphological facts into account.

One way to treat these morphological facts is in terms of shifting utterance costs. Speakers expend effort as they choose and select their utterances. Longer, less frequent collocations are costlier than their shorter, more frequent cousins. Thus, the morphological slimming-down of PROG exponents as they increase in frequency while grammaticalizing can be modeled as a decrease in the cost of uttering PROG relative to IMPF. In the following section, we present a model of the progressive-to-imperfective shift that operates over these shifting costs while reasoning about the utterance semantics.

4. The RSA model

We model the pragmatic reasoning that strengthens and refines the interpretations of PROG and IMPF within the Bayesian Rational Speech Act (RSA) framework, where speakers and listeners reason recursively about utterances and the world states those utterances describe (Frank and Goodman, 2012; Goodman and Frank, 2016, Scontras et al., electronic). In our model, a "lifted-variable" RSA variant, listeners also reason about the partitioned reference interval (I_{ref}) and superinterval (I_{sup}) under discussion. Put differently, our model assumes that listeners have uncertainty about the precise reference and superintervals that are relevant when interpreting utterances that appeal to grammatical aspect. Thus, we treat PROG and IMPF as vague, underspecified, or ambiguous utterances whose meaning gets fixed via active pragmatic reasoning (Lassiter and Goodman, 2013; Scontras and Goodman, 2017).

We model states of the world $s \in S$ as sets of indices at which the relevant predicate P holds. To allow for tractable inference, we imagine time as an interval bound between 0 and 10, with 0 corresponding to now (i.e., the reference time) and 10 corresponding to the distant future. We generate S as the powerset of the set of five atomic indices, less the empty set:

$$S = \mathscr{P}(\{t_1, t_3, t_5, t_7, t_9\}) - \emptyset$$

The partitioned intervals I_{ref} and I_{sup} all find their lower bound at the reference time, 0. Possible upper bounds include all integers from 4 to 10 with equal probability, with the constraint that the upper bound of I_{sup} be at least as great as the upper bound of I_{ref}. Intervals are partitioned into two equal-sized parts. Figure 5 represents I_{ref} $[0,3]$ (red box) and I_{sup} $[0,9]$ (blue box), together with two separate states: $\{t_1, t_3\}$ (red dots) and $\{t_3, t_7\}$ (blue dots). In the first state, the predicate holds at time indices t_1 and t_3; in the second, the predicate holds at t_3 and t_7. For purposes of model exploration, we treat the distinction between event-in-progress and characterizing scenarios as a gradient one: the closer the relevant indices are to the reference time, the more relevant the interpretation is to the event-in-progress reading; the farther the relevant indices are from the reference time, the more relevant the interpretation is to the characterizing reading. Thus, in Figure 5, only the event-in-progress scenario holds at t_1.

We consider three possible utterances: PROG, IMPF, and a NULL utterance corresponding to the speaker's saying nothing at all. To implement the uncertainty with respect to the relevant

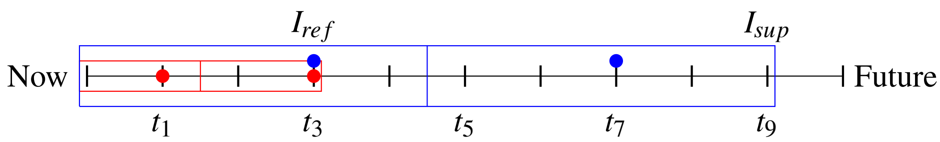

Figure 5: Visual representation of PROG (red) and IMPF (blue) verifying scenarios, where dots represent indices at which the relevant predicate P holds and boxes represent partitioned intervals.

partitioned intervals (i.e., I_{ref} and I_{sup}), we parameterize the interpretation function $[\![.]\!]$ so that interpretations depend on specific values of these parameters; the utterances receive the semantics in (8), a partial reformulation of Deo's semantics in (5).

(8) a. $[\![\text{PROG}]\!]^{I_{ref},I_{sup}} = \lambda s.\ \forall k[k \in I_{ref} \rightarrow \text{COIN}(P,k,s)]$
b. $[\![\text{IMPF}]\!]^{I_{ref},I_{sup}} = \lambda s.\ \forall k[k \in I_{sup} \rightarrow \text{COIN}(P,k,s)]$
c. $[\![\text{NULL}]\!]^{I_{ref},I_{sup}} = \lambda s.\ \texttt{true}$

In Deo's semantics, the requirement that the reference interval i be a subinterval of j guarantees that PROG entails IMPF, since IMPF involves existential quantification over these possibly improper superintervals. If PROG is true of the reference interval i, then certainly there exists an improper superinterval j—i itself—to satisfy IMPF. In contrast, our version of Deo's semantics does not maintain this entailment: since IMPF no longer involves existential quantification over superintervals, it is possible to choose particular values of I_{ref}, I_{sup}, and the world state s so that PROG is true but IMPF is not. Still, in a purely statistical sense, it remains true under our semantics that given a random world state s and pair of intervals $I = \langle I_{ref}, I_{sup}\rangle$, IMPF is more likely to be true than PROG, signalling that PROG is semantically stronger. In other words, when PROG is true, IMPF is extremely likely to also be true. Out of the 868 possible $\langle s, I\rangle$ pairs, IMPF is true of 543, while PROG is true of only 377. Crucially, of the 377 pairs of which PROG is true, IMPF is true of 365. However, when I_{ref} is particularly small, I_{sup} is particularly large, and the events in s are strongly clustered around the reference time, it is possible for PROG but not IMPF to truthfully describe s. This occurs in 12 of the pairs, and an example is shown in Figure 5; here, PROG holds because at least one red dot (i.e., at least one time index at which the predicate holds) falls in each half of I_{ref}, but IMPF does not hold because the dots are so tightly clustered that they do not fall in the second half of I_{sup}. Also note that IMPF certainly does not entail PROG, as IMPF holds for the blue dots in Figure 5 but PROG does not.

Utterance interpretation involves three levels of inference. At the base, the literal listener (L_0) interprets utterances according to their literal semantics; L_0 updates beliefs about the state of the world s (i.e., $P(s)$) conditioned on the semantics of u, together with some specified I_{ref} and I_{sup}. These interval variables are "lifted" to be resolved at a higher level of inference, giving rise to the "lifted-variable" classification for our RSA model (cf. Scontras et al., electronic). Hearing some utterance u with specific intervals in mind, L_0 returns a distribution over possible states s compatible with the literal semantics of u parameterized by I_{ref} and I_{sup}:

$$P_{L_0}(s|u, I_{ref}, I_{sup}) \quad \propto \quad [\![u]\!]^{I_{ref},I_{sup}} \cdot P(s).$$

One level up in the reasoning chain, the pragmatic speaker (S_1) chooses an utterance u to communicate some observed s to L_0 with respect to some specific I_{ref} and I_{sup}. S_1 makes this choice by maximizing the probability that u would convey s to L_0 while minimizing the utterance cost ($C(u)$); the temperature parameter $\alpha > 0$ controls S_1's optimality when maximizing utterance utility. Thus, S_1 returns a distribution over possible utterances u given some observed s, I_{ref}, and I_{sup}:

$$P_{S_1}(u|s,I_{ref},I_{sup}) \quad \propto \quad exp(\alpha \cdot [log(P_{L_0}(s|u,I_{ref},I_{sup})) - C(u)]).$$

Above S_1, the pragmatic listener (L_1) observes u and updates beliefs about s, together with the likely values for I_{ref} and I_{sup}. Thus, L_1 uses u to jointly infer the state of the world and the relevant intervals. L_1 performs this inference by reasoning about the process that generated the observed u: the probability that S_1 would have chosen u to communicate about s relative to some specific I_{ref} and I_{sup}. L_1 returns a joint distribution over states and intervals that are likely to be described by the observed u:

$$P_{L_1}(s,I_{ref},I_{sup}|u) \quad \propto \quad P_{S_1}(u|s,I_{ref},I_{sup}) \cdot P(s) \cdot P(I_{ref}) \cdot P(I_{sup}).$$

We use L_1 to model interpretation behavior. To model utterance use (i.e., speaker production behavior), we need one last layer of inference: a pragmatic speaker (S_2) who chooses utterances to communicate some observed state s to L_1 (Savinelli et al., 2017, Scontras et al., electronic). S_2 makes this choice by (softmax) maximizing the probability that L_1 would arrive at s from u, summing over the possible values for the intervals I_{ref} and I_{sup}. S_2 thus returns a distribution over utterances u for communicating the observed s to L_1:

$$P_{S_2}(u|s) \quad \propto \quad exp(\alpha_2 \cdot [log \sum_{I_{ref},I_{sup}} P_{L_1}(s,I_{ref},I_{sup}|u) - C(u)]).$$

To generate model predictions, we fix the free parameters of the model: the prior probabilities, α parameters, and utterance costs. By manipulating the relative costs of PROG and IMPF, we model their prevalence and morphological weight in a language at a particular stage of aspectual marking.

5. Model predictions

Figure 6 plots model predictions from two separate layers of our RSA model: L_1, which represents comprehension behavior (i.e., how the relevant utterances get interpreted), and S_2, which represents production behavior (i.e., how the relevant utterances get selected to communicate various states of affairs). Each facet of the plot represents a different hypothetical stage in the diachronic progression from progressive to imperfective. Each stage is characterized by the relative costs of the two utterances: from the first stage, where PROG is seven times as costly as IMPF, through the middle stage, where PROG and IMPF are equally costly, to the final stage, where IMPF is seven times as costly as PROG. The cost values for these stages are chosen arbitrarily; the values capture both the relative frequency and relative morphological weight of a given form, independent of its meaning. The precise costs assigned to IMPF and PROG at each stage are given in Table 2. For all stages, the α parameters are held constant at a "default" value of 1 (i.e., no scaling). Additionally, every world state s is assumed to be equally likely a priori.

Starting with the L_1 predictions (darker bars in Figure 6), we note the gradual expansion of PROG's interpretive possibilities as IMPF overtakes it in cost. In the initial stages where PROG

	Cost	
Stage	IMPF	PROG
Stage 1	1	7
Stage 2	1	5
Stage 3	1	3
Stage 4	1	1
Stage 5	3	1
Stage 6	5	1
Stage 7	7	1

Table 2: The costs of IMPF and PROG at each stage in Figure 6. In early stages, PROG has a higher cost than IMPF, while IMPF has a higher cost in later stages.

is significantly more costly (i.e., less frequent and morphologically heavier) than IMPF, PROG is interpreted almost exclusively as describing time indices close to the reference time; in other words, hearing PROG in the initial stages, L_1 interprets the utterance as describing events in progress. At Stage 4, where PROG and IMPF are equally costly, the two interpretations are largely overlapping, with PROG favoring states close to the reference time and IMPF signalling states farther into the future. This interpretive pattern persists, becoming slightly more pronounced, as IMPF overtakes PROG in cost.

While L_1's predictions indicate how a listener would interpret an utterance were they to hear it, the flip side of the communicative coin, S_2, models how likely the utterances are to be produced in the first place. As Figure 6 (lighter bars) demonstrates, S_2's behavior changes dramatically from Stage 1 to Stage 9. In the initial stages where PROG is much costlier, S_2 uses IMPF almost exclusively to communicate about all of the time indices. In other words, the prohibitive cost of PROG leads to a multi-purpose IMPF. Conversely, in the final stages where IMPF is much costlier, S_2 uses PROG almost exclusively to communicate about all of the time indices. It is only in the intermediate stages where PROG and IMPF are equally costly that S_2 regularly uses both utterances.

Taking in account both the L_1 and the S_2 predictions, we begin to get a clearer picture of the stages in the progressive-to-imperfective shift. The *emergent*-PROG stage, where PROG constructions are often periphrastic and less frequent, involves PROG constructions with a high utterance cost (i.e., morphologically complex and infrequent) relative to that of IMPF (Bybee and Dahl, 1989; Dahl, 1985). At this stage—spanning the early stages of our model—PROG is used almost exclusively with event-in-progress readings, but its high cost leads to an overall preference for IMPF for both event-in-progress and characterizing scenarios. As PROG's morphology streamlines, its cost lowers and it gets used more frequently. This leads to the *categorical*-PROG stage—the middle stages in our model—where the preference is for PROG to describe event-in-progress readings while IMPF describes characterizing ones. Already at the intermediate stages we see a broadening of PROG's meaning, but the cost symmetry between PROG and IMPF allows each utterance to carve out its own space of usage. In the *expanding*-PROG stage—the later stages of our model—PROG's meaning broadens yet more, and the relative cost of IMPF leads to an overall preference for PROG for both event-in-progress and characterizing scenarios; PROG has displaced IMPF in its usage. We thus see how considera-

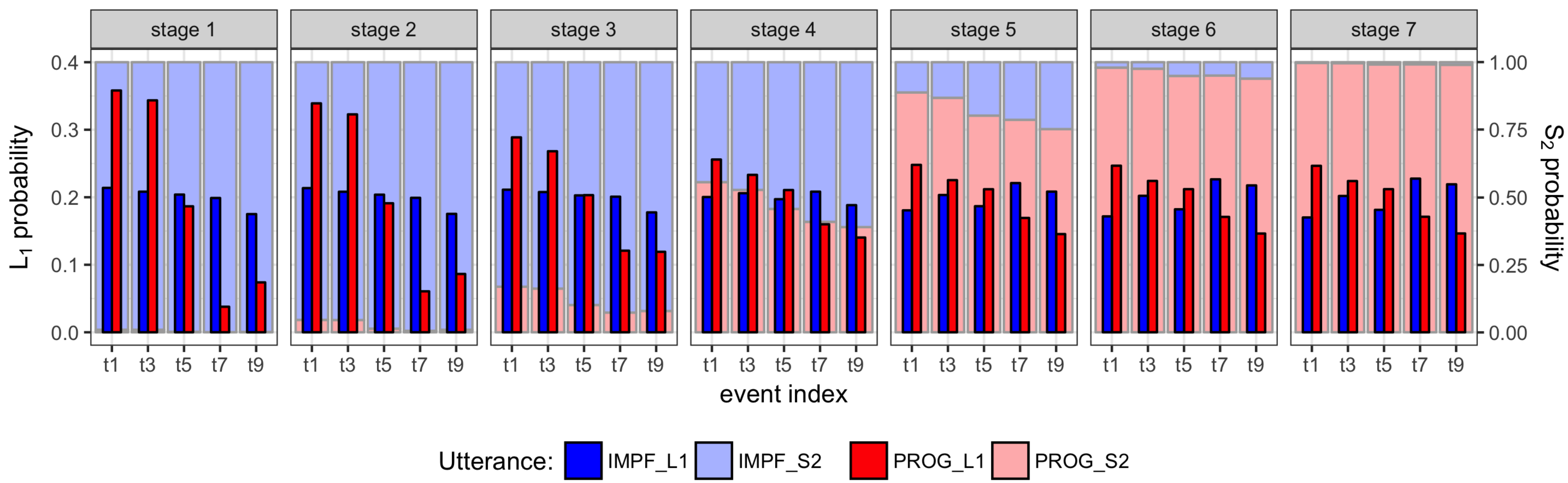

Figure 6: Predictions of our RSA model of the progressive-to-imperfective shift; predictions regarding IMPF appear in blue, while predictions regarding PROG appear in red. Dark bars represent predictions from the pragmatic listener L_1, which models interpretation behavior; higher values indicate that L_1 believes the utterance is more likely to hold at the relevant event index. Light bars represent predictions from the pragmatic speaker S_2, which models production behavior; higher values indicate that S_2 is more likely to choose the utterance to describe the relevant event index. Stages correspond to the relative costs of IMPF and PROG.

tions of utterance cost—without any shift in the semantics of the aspectual forms—can lead to the various stages of the progress-to-imperfective shift.

6. Discussion

By taking into account the shifting morphology that accompanies shifts in meaning, we are able to model changes in aspectual meaning while reasoning directly about utterance semantics. Our model thus captures the progressive-to-imperfective shift while reasoning pragmatically about a stable utterance semantics but changing utterance costs. Note that we have used Deo's semantics for theoretical continuity; any semantics with a similar entailment asymmetry between PROG and IMPF would deliver the same qualitative pattern of results. In what follows, we consider the implications of these results for our understanding of the progressive-to-imperfective shift and for theories of grammatical change more broadly.

6.1. Gradience of stages

The gradient predictions of our model suggest that the progressive-to-imperfective shift does not occur in discrete stages, but rather proceeds gradually as a function of changing utterance costs. This finding is supported by the empirical facts. Languages falling in, say, the *categorical*-PROG stage show subtle differences in their use of aspectual markers. In Bybee et al.'s (1994) study of three languages with an imperfective/progressive distinction, the authors found that the exponents in these languages overlap considerably in their domains of use.

For example, Yagaria, a language spoken in Papua New Guinea, has both a zero-marked imperfective and a progressive prefix *no-* (cf. Renck, 1975, via Bybee et al., 1994). The zero-marked IMPF "relates actions in the present, or, as 'historic present', relates actions which took place in the past" (Renck, 1975: 86). IMPF gets used less frequently than PROG, which can describe both events in progress and habitual actions (i.e., characterizing scenarios), as in (9).

(9)	ba	no-	d-	on-	e
	sweet potato	PROG	eat-	1p-	IND

'we are eating sweet potatoes now' or 'we usually eat sweet potatoes'

The view of the progressive-to-imperfective shift presented in Section 2 has nowhere to account for this pattern. The problem lies in the discrete stages. Yagaria does not fall into the *categorical*-PROG stage (i.e., stage 3), since its PROG can be used with both event-in-progress and characterizing scnearios. It also does not fall into the *generalized*-PROG stage (stage 4), since IMPF still serves as a viable option for characterizing scenarios. Rather, Yagaria exists somewhere between the two stages.

Another problematic language for the discrete-stages view is Alyawarra (Pama Nyungan; Australia), which has an older imperfective exponent *-ima* and a progressive exponent *-iyla* (Yallop, 1977, via Bybee et al., 1994). These markers have largely overlapping domains of use, but *-iyla* "is preferred for the description of present happenings" (Bybee et al., 1994, 145-6). However, Bybee et al. (1994) point out that progressive *-iyla* has a fairly wide distribution, finding use with both stative predicates and habitual contexts, as in (10).

(10) nga angkiyla alyawarra, ra angkiyla arirnta
2.S.NOM speak:PROG Alyawarra, 3.S speak:PROG Aranda.
'You speak Alyawarra, he speaks Aranda'

As with Yagaria above, Alyawarra's multi-purpose PROG in the context of a grammatical IMPF fails to fit neatly into the discrete-stages view. Moreover, the Alyawarra case seems to differ from the Yagaria case because here the older IMPF is still actively used alongside the newer PROG (cf. the asymmetry of usage in Yagaria).

In fact, we already encountered data along these lines when we considered Tigre in Section 1 above. There, we saw that in Tigre PROG can be used for both event-in-progress and characterizing scenario. Like Yagaria and Alyawarra, Tigre seems to fall somewhere between the *categorical*-PROG and *generalized*-PROG stages. The Tigre imperfective, however, has also acquired a "new" futurate interpretation—we return to this point in the following subsection.

These data suggest that languages do not fit neatly into a view where the progressive-to-imperfective shift proceeds in discrete stages. All three of these languages seem to fall somewhere in Deo's *categorical*-PROG stage, yet each behaves differently in subtle ways. The gradient nature of our model is well-suited to capturing these facts. Indeed, we see already in Figure 6 that as PROG takes hold in the language, its usage expands to cover characterizing scenarios *even in the presence of a viable* IMPF *alternative*. This is precisely the pattern we find in Yagaria, Alyawarra, and Tigre.

6.2. Futurity and IMPF

Our model further predicts that imperfectives begin to take on futurate uses: in the later stages, both interpretation and production behavior for IMPF begins to shift toward later time indices (blue bars in Figure 6). Again, this prediction appears to bear out in the language data. To see how, we return again to Tigre.

We presented a somewhat simplified view of the Tigre details above. In fact, the language has an imperfective present verbal form and two periphrastic progressive forms, one for past situations and the other for present situations (Raz, 1983). Like Alyawarra, both exponents enjoy frequent use. The imperfective form is used with stative predicates, habitual actions, and the historic present. Crucially, IMPF is also used to indicate futurity. The two uses of IMPF are illustrated below, where (11a) involves a habitual interpretation of IMPF, and (11b) involves a future interpretation.

(11) a. ʔət bet məhro kəl dol ʔassabuħ sʕassamaːn ʔəgayəs
To school all time in the morning at eight o'clock go-IMPF.1SG
'I go to school every day at eight o'clock in the morning.'
b. haqo kəlʔe ma salas məʕəl ʔaqabbəl
after two or three day return-IMPF.1SG
'After two or three days, I shall return.'

Kui (Dravidian; India) represents another example of this shift toward the future. The so-called "future" in Kui, a suffix *-in*, has both future uses and characterizing uses. Thus, IMPF in (12) is ambiguous between the two readings (Winfield, 1928).

(12) ānu tāki-i
1SG walk-IMPF
'I shall walk.' or 'I walk.'

In fact, this prediction bears out quite generally: imperfectives are a common source of future exponents. Many of these exponents obtain their future use after having their domain of use constrained by a competing progressive, though they usually retain some of their more general imperfective meaning (Bybee et al., 1994, 153, 276). Thus, these future uses are usually later developments, after a progressive exponent has generalized in use quite broadly. This is precisely the pattern our model predicts.

6.3. Consequences for theories of grammatical change

Theories of grammatical change vary, but ultimately often involve a change in the core meaning of a lexical item. For example, several theories argue that implicatures or other "invited inferences" become incorporated into the asserted meaning of a lexical item (Eckardt, 2006; Traugott and Dasher, 2002). Other theories argue that the conceptual structures associated with a word change over time (Danchev and Kytö, 1994), perhaps involving a kind of metaphoric transfer (Heine et al., 1991; Hopper and Traugott, 2003). While some cases of grammaticalization may require such a lexical change, however it may be implemented, our model suggests that the progressive-to-imperfective shift does not require the lexical entries of PROG or IMPF to change at all. Instead, factors *external* to interpretation may change—in this case the cost of the utterance (a function of morphological complexity and frequency of use)—but the denotations of the lexical items themselves can remain constant.

If this line of thinking is on the right track, then understanding the pragmatic factors at play external to grammar is at least as important to understanding changes in grammar as understanding the shifting semantics. As a consequence, when considering diachronic changes in meaning, it is also necessary to take into account morphosyntactic reduction and other changes in form and usage. The current work demonstrates how these latter factors alone can lead to changes in interpretation without any changes in the semantics. Indeed, this conclusion was assumed already in Deo's model, where what shifts are the speaker-hearer conventions, not the semantics of PROG and IMPF.

7. Conclusion

The interpretation and use of grammatical aspectual devices changes with time: progressive exponents slowly broaden in meaning, encroaching on the territory of the older imperfective. Inspired by Deo's (2015) model of this change, we have offered our own model within the RSA modeling framework. With a strength asymmetry in the semantics of PROG vs. IMPF, interpretation depends crucially on the utterance costs, and these costs change as a function of the morphology and frequency of use. While there surely exists a need for semantic reanalysis in cases of grammatical change, or model provides a proof-of-concept for the notion that interpretation and use can change as a function of the relative costs of the relevant utterances. Thus, we have shown how pragmatic reasoning can drive semantic change.

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Shifting perspectives in pictorial narratives[1]

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Abstract. We propose an extension of DRT for analyzing pictorial narratives. We test drive our PicDRT framework by analyzing the way authors represent characters' mental states and perception in comics. Our investigation goes beyond Abusch and Rooth (2017) in handling not just free perception sequences, but also a form of apparent perspective blending somewhat reminiscent of free indirect discourse.

Keywords: pictorial semantics, projection, visual narrative, comics, perspective, perception and attitude reports, free indirect discourse, DRT.

1. Introduction

Semantics is the study of meaning, where meaning is typically equated with truth conditions, in turn equated with sets of possible worlds. Semanticists study the truth-conditional contributions of various linguistic constructions (belief ascriptions, the German particle *ja*, etc.). But there are many non-linguistic human artifacts and activities that can be fruitfully analyzed as having truth-conditions and propositional content. Maps, gestures, traffic signs, paintings, mime performances, emoji, comics, ballet, music etc. Some of these can be highly effective means of communicating information, or of telling a vivid story. Some, like traffic signs, achieve their communicative function in a rather language-like way, with a more or less conventionalized, symbolic lexicon and some rules of composition. On the other side of the spectrum we have photography and mime, which convey information iconically, i.e. they depict what they are about by virtue of resemblance rather than mere convention.[2]

Recent advances in formal semantics, some under the header of 'super semantics', have aimed at capturing iconicity and depiction within the possible worlds framework that has proven so successful in linguistics (Schlenker, 2017, 2018).[3] In this paper we continue the pioneering work on the formal semantics of comics started by Dorit Abusch (2013, 2014). More specifically, since attitude and speech reports have proven such a driving force behind linguistic semantic theorizing ever since Frege (1892), we will here take a closer look at the ways attitudes are represented in comics. Our study thus adopts linguistic semantic tools to capture certain salient modes of attitude representation in pictures and comics, but in the end it turns out that our investigation of pictorial viewpoint shifting also sheds new light on linguistic viewpoint shifting phenomena.

2. Picture semantics

The centerpiece of a modern linguistic semantics formalization is a recursive definition of truth for a language, relative to a possible world: $[\![\varphi]\!]^w = 1$ iff .... Once this recursive definition is

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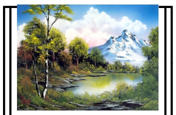
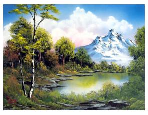
[2]See Giardino and Greenberg (2015), Greenberg (2013), Schlenker (2018) for more on iconicity and resemblance in formal semantics.

[3]However, see also Zimmermann (2016) for a critical look at the idea that pictures, like sentences, express possible worlds propositions.

in place, the content or proposition expressed by a sentence φ is then easily defined as the set of worlds where φ is true. Pictures, especially photos, do not obviously have compositional structure, but they are about something and we can capture that with the help of a definition of truth in a world. A picture is true with respect to a possible world w iff there is a point v in w from where w 'looks like' the picture.

Following Abusch (to appear), Greenberg (2013) and many others we can make this semantics more precise in terms of a projection function. A projection function π is a recipe for collapsing a 3D scene into a 2D plane. Formally, π takes a world w and a viewpoint v, and returns a picture p: $\pi(w,v) = p$. There are many different kinds of projection functions: we have linear, curvilinear, and parallel projections, projections that create black-and-white line figures with shading, and projections that retain a full range of colors realistically. We can think of this variation in terms of additional projection parameters, together defining a certain drawing style. In other words, a picture may be true of a world (from a given viewpoint) under certain parameter settings but false under certain other parameter settings. We will assume that the context determines the right settings of these parameters and then ignore them in our notations below.

Summing up, we use the projection function π (with contextually set parameters for perspective type, edge-to-line-conversion type, colors, etc) to define when a given picture is true of a world, from a given viewpoint:

(1) $\left[\!\left[$  $\right]\!\right]^{v,w} = 1$ iff $\pi(w,v) =$ 

From there we define propositional content (as the set of worlds in which the picture is true from some viewpoint):

(2) $\left[\!\left[$  $\right]\!\right] = \left\{ w \;\middle|\; \exists v \left[\!\left[$  $\right]\!\right]^{v,w} = 1 \right\}$

3. From propositions to stories

3.1. The Dynamic Turn

Already in the 1980's, semanticists started looking beyond classical propositions to model the interpretation of utterances in the context of larger discourse. In dynamic semantics, the meaning of a sentence is not primarily the proposition it expresses, but rather the way it affects the context, i.e. the information conveyed by the discourse up to that point and further background knowledge shared by the participants. One particularly successful dynamic framework is Discourse Representation Theory (DRT, Kamp, 1981). Below we illustrate the DRT framework with a textbook example of dynamic interpretation in language (from Geurts, 1999), before we introduce an extension to DRT we call PicDRT that is able to model the dynamics of multi-panel visual story-telling.

In DRT, information is representated in the form of a Discourse Representation Structure (DRS). In (3b) we have represented the information conveyed by (3a), viz. that there exist a policeman and a squirrel and the former chased the latter, in the standard box notation for

DRS's.

(3) a. A policeman chased a squirrel.

b.

$x\ y$
policeman(x) squirrel(y)
chase(x,y)

To interpret the next utterance in the discourse, (4a), we first add its compositionally generated logical form to the current discourse representation, representing pronouns as discourse referents that need to be resolved (=?).

(4) a. He caught it.

b.

$x\ y\ z\ w$
policeman(x) squirrel(y)
chase(x,y)
catch(z,w)
$z = ?\ \ w = ?$

We then proceed to resolve all the unknowns, by finding suitable antecedents among the accessible discourse referents. In this case, z (representing the pronoun *he*) binds to x (the policeman), w to y. We may then simplify by unifying the equated discourse referents to get the eventual output DRS in (5b).

(5) a.

$x\ y\ z\ w$
policeman(x) squirrel(y)
chase(x,y)
catch(z,w)
$z = x\ \ w = y$

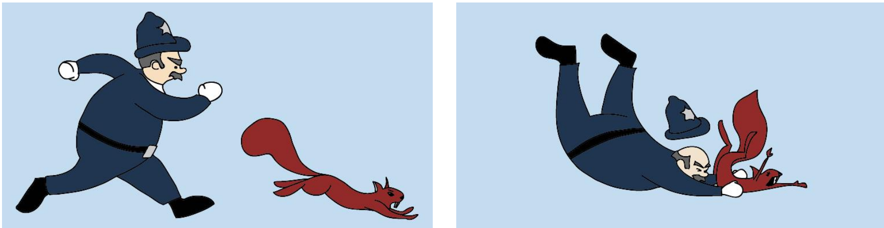
b.

$x\ y$
policeman(x) squirrel(y)
chase(x,y)
catch(x,y)

In this way we end up with an updated DRS representing the information conveyed by the two-sentence discourse. A next sentence could continue adding information about the policeman and the squirrel, using pronouns or other definites to refer back to these old discourse referents (*it bit him*), or it could introduce new discourse referents, using indefinites (*a woman was standing nearby*). This way of cashing out the fundamental distinction between definites (introducing discourse referents that want to be bound to previously established ones) and indefinites (introducing new discourse referents) is one of the basic features of DRT. It is also here that pictorial discourse differs somewhat from linguistic discourse.

3.2. Introducing PicDRT

We can tell Geurts's simple mini-story also without words.

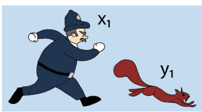
(6) 

The juxtaposition of pictures in (6) is quite naturally interpreted as representing a temporal progression of two closely related events, the first picture shows a policeman chasing a squirrel, and the second shows him catching it. In this section we extend DRT with picture conditions and discourse referents to model that interpretation of sequential images (or comics, McCloud, 1993; Cohn, 2013b).

3.2.1. The PicDRT language

We'll extend the formal language of DRS's with picture conditions, consisting of a picture discourse referent (p_i) and an actual picture.[4] To capture the intuition that the policeman in the second picture refers to the same policeman as in the first, we need to impose some structure on pictures inside a PicDRS. We need to somehow identify discourse referents in the pictures (Abusch, 2013). We'll assume that the DRS construction algorithm manages to identify some regions of interest in a picture, viz. those regions that correspond to salient entities (like the policeman and the squirrel in (6)), and label those regions with fresh discourse referents. The first picture of the story in (6) will be represented in PicDRT as:

(7)

$p_1 \ x_1 \ y_1$
p_1: 

What this means is roughly that there is a situation or event[5] in the world that (from some viewpoint) looks like the picture, and in that situation there are two salient individuals, who look like the two regions labeled in the picture. We return to the model-theoretic/semantic details below, after we first illustrate the dynamics of the system.

3.2.2. PicDRT dynamics and pragmatics

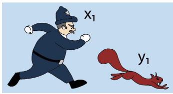
The motivation for introducing discourse referents in pictures is to model the dynamics of storytelling with picture sequences. In the linguistic version of the story, (3)–(4), the second utterance could refer back to previously established discourse referents by using pronouns. As Abusch notes, there are no obvious pictorial analogues of pronouns (or definites or presupposition triggers more generally). There is nothing in the second picture that specifies that the

[4]This makes a lot of sense if we think of DRS's as mental representations, which are quite naturally thought of as partly symbolic, partly iconic (visual/pictorial).
[5]We leave the tricky ontological details for another occasion (e.g. Should we use situation or event semantics? Should we label the event(s) with event discourse referents in the picture? Can an event even be depicted?)

depicted squirrel and policeman must be familiar from previous discourse rather than representing two new agents that just look similar. We'll assume, with Abusch, that each picture in a sequence introduces its own new discourse referents corresponding to salient regions, and it is left to pragmatics to determine whether some are to be treated as coreferential. Updating the representation in (7) with the second picture in (7) thus yields (8a). Pragmatic reasoning based on assumptions of coherent storytelling will allow the reader to conclude that the second policeman is likely the same as the first, and similarly for the squirrel, which gives us the pragmatically strengthened representation in (8b).

(8) a.

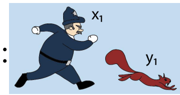
$p_1\ x_1\ y_1\ p_2\ x_2\ y_2$

p_1: 

p_2: 

b.

$p_1\ x_1\ y_1\ p_2\ x_2\ y_2$

p_1: 

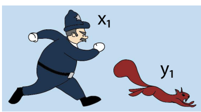
p_2: 

$x_2 = x_1 \quad y_2 = y_1$

The pragmatically enriched PicDRS output in (8b) means roughly the same as the DRS output we derived for the linguistic story before: there's a situation that looks like the first picture, with two agents, looking like the two labeled regions, and there is another situation that looks like the second picture, with these same two agents, now looking like like the two labeled regions in the second picture. However, the ways in which we derived those outputs are importantly different. In the linguistic case, the coreference was encoded in part by the linguistic structures (pronouns) themselves, while in the pictorial case, it's purely pragmatic, i.e. it's ultimately up to the interpreter to interpret the second policeman as the same as in the first picture, or as a completely different new one. Similar points can be made about the temporal, aspectual, causal, and coherence relations that connect the two discourse units. For instance, the fact that the second sentence is interpreted as describing an event immediately following the first is partly determined by the choice of tense and aspect morphology on the verbs. In the pictorial version, there is no (obvious) analoguous morphology expressing temporal progression. Indeed, as McCloud (1993) already notes, juxtaposition of pictures in a comic may occasionally correspond to overlapping state descriptions, simultaneous shots from different viewpoints, or flashbacks and jumps in time, so we'd do well do leave this temporal ordering, again, to pragmatic strengthening. We will however assume that, by default, a picture to the right or below (in Western comics and picture books) another corresponds to a state of affair that comes later. We model this by adding a DRS condition of the form $p_1 < p_2$.

(9)

$p_1\ x_1\ y_1\ p_2\ x_2\ y_2$

p_1: 

p_2: 

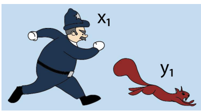
$x_2 = x_1 \quad y_2 = y_1 \quad p_1 < p_2$

3.2.3. PicDRT semantics

In standard DRT we define when a DRS is true relative to a world w and a partial assignment or embedding f mapping some discourse referents to individuals in the domain of the model (as usual for any first-order language). For PicDRT we'll need to add a third parameter v providing viewpoints for the interpretation of the picture conditions (as described in section 2). Since pictures in a comic tend to represent the world from a variety of viewpoints (in space and time) we need our v to provide not one but a sequence of viewpoints, one for each picture condition. Formally, let's say v is a partial mapping from the set of pictorial discourse referents $(\{p_1, p_2, p_3 \ldots\})$ to points in space-time. Viewpoint functions then can be treated analogously to standard DRT's verifying embeddings, but for pictorial discourse referents.

Let's illustrate with our (pragmatically strengthened) PicDRS output, (9), from above. The starting point is that we use an assignment function f to verify the regular DRS conditions (relative to w), and a viewpoint function v to verify the pictorial conditions (also relative to w, using the projective definition of truth from section 2 above). Finally, since the regular, descriptive discourse referents also correspond to picture regions we must make sure that f and v are properly aligned (see (10c)).

(10) $\Bigg[\!\!\Bigg[$ p_1 x_1 y_1 p_2 x_2 y_2

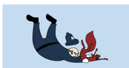
p_1: 

p_2: 

$x_2 = x_1$ $y_2 = y_1$ $p_1 < p_2$ $\Bigg]\!\!\Bigg]^{w,v,f}$ =1 iff . . .

. . . iff there is a verifying embedding $f' \supset f$ with $Dom(f') = \{x_1, y_1, x_2, y_2\}$ and a viewpoint function $v' \supset v$ with $Dom(v') = \{p_1, p_2\}$ such that:

a. f' verifies the descriptive conditions:
   (i) $f'(x_2) = f'(x_1)$
   (ii) $f'(y_2) = f'(y_1)$

b. v' verifies the pictorial conditions:
   (i) $\pi(w, v'(p_1)) =$ 
   (ii) $\pi(w, v'(p_2)) =$ 
   (iii) $v'(p_1) < v'(p_2)$ (the viewpoint associated with p_1 temporally precedes that associated with p_2)

c. f' and v' are aligned:
   (i) $\pi(f'(x_1), v'(p_1)) =$  (the policeman-region in the picture is a projective (partial) depiction of the policeman represented by x_1, from the viewpoint associated with the picture)
   (ii) $\pi(f'(y_1), v'(p_1)) =$ 
   (iii) $\pi(f'(x_2), v'(p_2)) =$ 
   (iv) $\pi(f'(y_2), v'(p_2)) =$ 

Note that the extension of DRT semantics sketched here allows us to deal with recursive embedding of PicDRS's in complex conditions with intensional operators, which we'll encounter below. It also allows us to define the usual semantic notions of content, like the classical propositional content of a PicDRS:

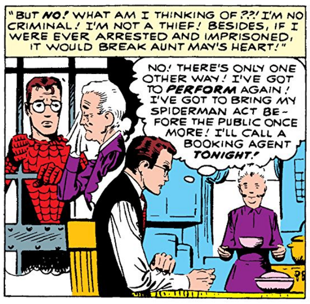
(11) $[\![K]\!] = \left\{ w \,\middle|\, [\![K]\!]^{w,\emptyset,\emptyset} = 1 \right\}$

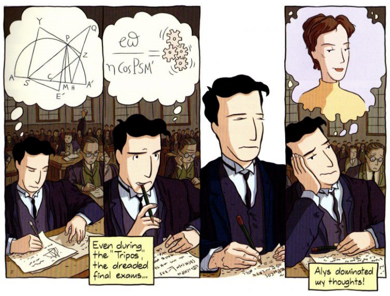
4. Picturing speech and thought

In natural language semantics, from its Fregean beginnings in philosophy, attitude and speech reports have always played an important role. As a case study for our PicDRT framework, let's see if we can adequately describe the various attitude reporting strategies in pictorial narratives, starting with a few remarks about the obvious speech and thought bubbles, through free perception sequences, and ending with what we call blended panels.

4.1. A note about bubbles

One of the most recognizable features of contemporary comics are speech and thought bubbles. These devices are used to convey a character's utterances or inner thoughts, as is illustrated in (12) below. Usually, the utterances and thoughts are represented verbally, in written language. Such bubbles can be straightforwardly analyzed as the visual language analogue of quotation marks in language (Saraceni, 2003). Interestingly, comics also allow for the use of pictures inside thought (and, more rarely, speech) bubbles to represent an agent's thoughts or other mental states iconically.[6]

(12) a. 

b. 

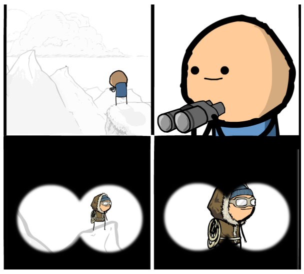
We choose to leave a detailed analysis of speech and thought bubbles as a form of quotation (or demonstration) for a future occasion. Instead we want to focus here on arguably more purely pictorial modes of representing mental states. For an extensive analysis on speech and thought bubbles in comics within a different kind of framework, see Cohn (2013a).

4.2. Free perception and viewpoint shift

Abusch and Rooth (2017) discuss the phenomenon of free perception sequences in wordless comics as a way to represent what a character is seeing. Typically, we have a panel showing a character looking, followed by a panel depicting what they see, as if through their eyes.[7]

[6] (12)a: *The Amazing Spider-Man #1*, 1963, Marvel Comics; (12)b: *Logicomix: An epic search for truth*, 2015, Bloomsbury Publishing USA.
[7] (13)a: *Hostage*, 2017, Vintage Publishing. (13)b: *Cyanide and Happiness*, 2018, `http://explosm.net/comics/4913/`.

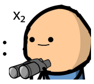
(13) a. 

b. 

Following Abusch and Rooth (2017) we can analyze this kind of perception representation purely extensionally: the two pictures just describe the same (set of) world(s), but from two different viewpoints. Basically, interpreting the sequence involves fixing the viewpoint for the perception panels on to the location of the protagonist's eyes (at the looking time).

We can model this in PicDRT by introducing a special predicate 'view(x, p)' to capture the viewpoint shift. Note that the view-condition is, again, a pragmatic inference, drawn by the careful reader familiar with film and comic conventions like the setup panels focusing on the character's eyes.

(14)

$\ldots p_2\ \ x_2\ \ p_3\ \ x_3$
$\ldots\ p_2$:  p_3: 
$\ldots$ view(x_2, p_3)

As stated, the semantics of this view-condition is purely extensional:

(15) $[\![\text{view}(x_2, p_3)]\!]^{f,v,w} = 1$ iff $v(p_3)$ corresponds to the location of the eyes of $f(x_2)$ (and the time of looking) in w

On this approach we're not really dealing with the representation of perception as a mental state.

The question arises whether there might be a linguistic analogue of this type of free perception representation. Abusch and Rooth (2017) refer to work by Brinton (1980) and Hinterwimmer (2017), who discuss the phenomenon of 'represented perception' in narratives (see also Banfield 1982 on 'representing non-reflective consciousness'). Two examples are given below:

(16) a. He looked at his mother. Her blue eyes were watching the cathedral quietly. (D.H. Lawrence *Sons and Lovers*, cited by Brinton, 1980)

b. Sara got up and went to the window. A crowd had gathered outside the public house. A man was being thrown out. There he came, staggering. (Virginia Woolf *The Years*, cited by Banfield, 1982)

In (16a) the second sentence is most naturally interpreted as a description of what the subject of the first sentence was seeing. In (16b) the choice of the deictic *came* (rather than *went*) suggests that indeed the scene is described from the perspective of the salient viewing character, Sara.

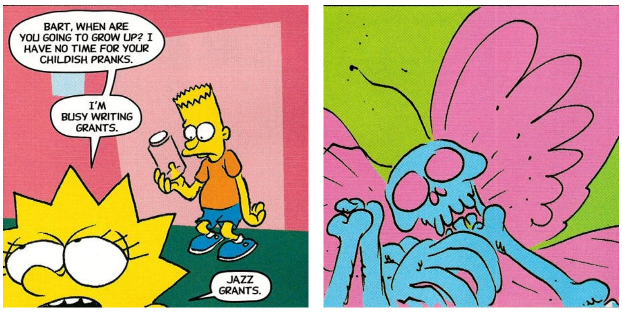
4.3. Non-veridical free perception

Apart from evidently extensional viewpoint shifting – i.e. veridical free perception, in Abusch and Rooth (2017) terminology – there are also cases in which a narrative describes a fictional character's visions, dreams or hallucinations that are clearly not veridical. In (17) Rorschach is shown an inkblot which triggers a visual memory of a dead dog.

(17) 

[8]

Unlike in the sequences in (13) above, the dead dog is just in the protagonist's mind and is not part of the actual scene. In (18), Bart Simpson is shown looking at an empty jar, followed by a representation of what he sees, a dead fairy in the jar.

(18) 

[9]

As in the previous cases of free perception, the second panel seems to depict the situation as viewed from Bart's geometric viewpoint, but instead of depicting the story world itself, it depicts the world according to Bart. Similarly, the last picture from the *Watchmen* sequence in (17) shows what Rorschach brings to his memory while looking at the drawing. In this sense, the picture is also a case of non-veridical perception as it does not represent the actual scene, but represents a scene from a different time that the protagonist brings to his mind.

In order to capture non-veridicality in our framework, we need an intensional operator here. Abusch and Rooth essentially posit such a hidden operator in the syntactic structure of the second picture. By contrast, we adopt a pragmatic approach and derive the insertion of a relevant operator on the basis of Eckardt's (2014) notion of a Cautious Update. To introduce this concept we take a little detour into the pragmatics of non-cooperative communication.

Linguists tend to assume idealized cooperative exchange situations in which the speaker intends to provide reliable information and the hearer trusts the speaker. In this case, asserting a proposition p means adding it to the common ground. This, Eckardt calls a Trust Update. However, a hearer may well distrust or disagree with the speaker. In such cases, the hearer may not accept the speaker's assertion that p and refrain from adding p to the common ground.

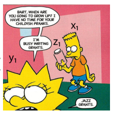
[8] *Watchmen*, 1987, DC Comics.
[9] *Bart Simpson's Treehouse of Horror #12*, 2006, Bongo Comics.

Instead, the hearer may accept something weaker, e.g. that the speaker believes that p. In Eckardt's terminology, we do a Cautious Update: instead of accepting and updating with p we update with $Bel_x p$.[10]

We can now view our non-veridical sequences as requiring the reader to perform a kind of Cautious Update, because a straightforward Trust Update will lead to an incoherent output where an inkblot suddenly changes into a dead dog, or a jar is empty the one moment and then contains a mythical creature the next. In PicDRT, we distinguish now two types of update. So far we've modeled the PicDRT Trust Update, which will always be the default interpretation strategy. Applied to the Simpsons comic, this standard update would lead to an incoherent output, even if we infer an extensional viewpoint shift condition, as shown in (19):

(19)

$p_1 \; x_1 \; y_1 \; z_1 \; p_2 \; x_2$

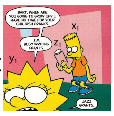
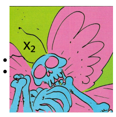
p_1:  p_2: 

view(x_1, p_2)

On this reading, Bart holds an empty jar and as soon as he looks at it a dead fairy appears. This is inconsistent with the rest of the story because it would predict that Lisa and others would be able to see the creature whenever Bart looks at it, which is clearly not the case. Whenever a Trust Update fails to get a coherent output we may resort to Cautious Update, which means that we add a suitable attitude operator to the information from the second picture. For these pictorial cases we'll assume a perceptual attitude operator, $PERC_x$, meaning something like 'x mentally perceives that ...', (20b). We'll further assume that the referent for the perceiving agent x can be bound to any currently salient discourse referent.

(20) a.

$p_1 \; x_1 \; y_1 \; z_1$

p_1:  $PERC_{x_1}$ [$p_2 \; x_2$ | p_2: ]

b. $[\![PERC_{x_1} K]\!]^{f,v,w} = 1$ iff for all $\langle w', v' \rangle$ compatible with x_1's *de se* 'perceptual experience' (i.e. $v'(p_i)$ is the viewpoint from where $f(x_1)$ experiences world w' for all p_i in $U(K)$): $[\![K]\!]^{f,v',w'} = 1$

Note that by using a monstrous operator $PERC_x$, modeling *de se* perception, we account for both the free perception's visual viewpoint shift and the non-veridical, attitudinal embedding at once.

We conclude this discussion of free perception by again pointing out that there are seemingly

[10]Eckardt goes on to use this mechanism also for the interpretation of free indirect discourse. See Altshuler and Maier (to appear) for another application of Cautious Update in DRT. See Asher and Lascarides (2013) for more on non-cooperative conversation, and Kamp (2016) for another way to handle updates from unreliable conversion partners in a mentalistic variant of DRT.

analogous phenomena in the linguistic domain. The following example, from *The Shining*, describes a scene where the hotel manager gives Jack, Wendy and Danny a tour of the hotel and Danny has a vision while they are admiring the presidential suite:[11]

(21) Jack and Wendy were so absorbed in the view that they didn't look down at Danny, who was staring not out the window but at the red-and-white-striped silk wallpaper to the left, where a door opened into an interior bedroom. And his gasp, which had been mingled with theirs, had nothing to do with beauty. Great splashes of dried blood, flecked with tiny bits of grayish-white tissue, clotted the wallpaper. It made Danny feel sick.

The splashes of dried blood are part of Danny's psychic vision. It is clear from the rest of the story that there really is no blood to be seen there. The narrator describes the scene as mentally perceived by Danny. In our Eckardt-based approach, this means the reader is supposed to perform Cautious Update, interpreting the final passage as embedded under a mental perception operator like in (20b).

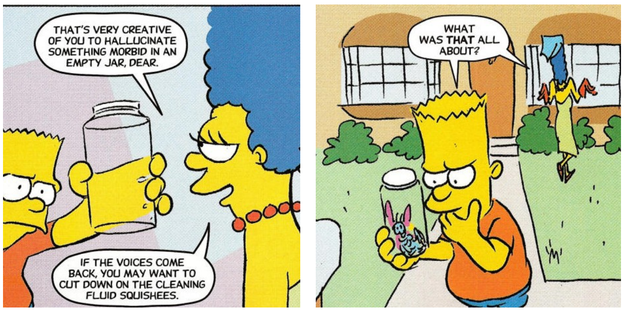
4.4. Perspective blending

We have dealt with sequences of pictures involving perspective shifting from one picture to another. However, in comics (as well as in other media like film) it is very common to depict a character and their subjective experience (faulty perception, imagination, dreams etc.) in a single image (or scene, in the case of film). In (22a), from the same *Simpsons* story as the above, Bart is depicted as holding the jar with the fairy inside, though it's still evidently only visible to him. In (22b) Batman's sidekick Robin is hit by Scarecrow's fear toxin and has to confront his own worst nightmares, which are depicted from various angles, but none of them from the perspective of Robin himself (as he himself is visible on almost every panel). In (22c) we first see Calvin with his friend Susie; followed by a depiction of that same scene in the way Calvin himself imagines it.[12] [13]

[11] Stephen King, *The Shining*, 1977.

[12] Zimmermann (2016) points out a similar case of blended, non-veridical perception in Ferdinand Bol's 1642 painting *Jacob's dream*. Another example is Antonio de Pereda's 1650 *The Knight's Dream* which depicts a sleeping knight next to the contents of his dream, an angel and various symbols of vanity.

[13] (22)b: *Batman and Robin Eternal #2*, 2015, DC Comics; (22)c: *Calvin and Hobbes*, Andrews McMeel Publishing.

(22) a. 

b. 

c. 

Because such images depict the perceiving, dreaming or hallucinating character (from an apparently neutral viewpoint), alongside the contents of their subjective experience, it seems that two perspectives are 'blended' in a single image. Such mixing of perspectives is reminiscent of the phenomenon of free indirect discourse in linguistic narrative, which is likewise characterized as blending two simultaneous perspectives or voices. Consider the example in (23).

(23) She looked at the calendar. But…then the deadline was tomorrow! How was she supposed to fix that bloody paper in one day?

The second sentence in (23) describes what the protagonist is thinking, while looking at the calendar. On the one hand it thus represents the world from the protagonist's perspective, faithfully capturing her mood by means of exclamation, hesitation, and question marking, and by the use of indexicals like *tomorrow* reflecting the protagonist's perspective. On the other hand, the third person pronouns and past tenses reflect the neutral narrator's perspective.[14]

There are two main types of semantic approaches to free indirect discourse. The quotational approach treats it as a form of quotation, where pronouns and tenses are systematically unquoted (Maier, 2015, 2017). Bicontextual approaches introduce a second, shifted context parameter ('context of thought' or 'protagonist context') that takes care of the shifted interpretations of indexicals like *tomorrow* in (23) (Schlenker, 2004; Eckardt, 2014). Either way, the effect is that part of a free indirect discourse passage will be semantically interpreted relative to the neutral, narrator's perspective/context, while other parts get interpreted relative to the protagonist's perspective/context. So let's see if we can translate that insight to our pictorial blends.

Take another example, (24a), where we see the protagonist, Joe, and his hallucinations – his toys having come to life and surrounding him. Following the free indirect discourse approach, part of the picture should represent the actual state of affairs in the story, the part depicting Joe lying on the floor, while the rest of the picture represents Joe's subjective experience. Sticking

[14]For a short overview of different narratological theories about Free Indirect Discourse, see Bray (2007).

with a free indirect discourse approach thus entails that in interpreting (24a) we essentially split the picture in two parts, separating the experiencer, depicted from the neutral perspective, from the subjective experience itself, as in (24b).[15]

(24) a.  b. 

In this way, interpreting the original blended picture is reduced to splitting the perspectives (just like we separate the quotation/protagonist-oriented and unquotation/narrator-oriented parts of a free indirect discourse in our familiar semantic approaches to the linguistic phenomenon) and then interpreting the result essentially as a non-veridical free perception sequence.

On closer inspection this linguistically inspired approach gives the wrong result. Unlike in a free perception sequence, the viewpoint remains stable in (24b). The subjective experience part, where Joe is cut out, presents Joe's mental state, but not from his perspective. The *Calvin and Hobbes* passage in (22)c makes this even clearer. The blended panel presents the scene from the exact same neutral viewpoint as the previous panel. In addition, note that it would be impossible to split that picture into an experiencer, Calvin, and his experience, as his experience affects the way Calvin himself is depicted (as an astronaut).

In sum, a blended picture presents a scene from a single viewpoint, the narrator's, not the protagonist's, and is thus not strictly speaking a case of 'dual voice' after all. Instead, we can think of the blended panels as the analogues of (nonmonstrous) indirect discourse and attitude reports in English.

(25) Joe dreamed that he was surrounded by his toys

An indirect report like (25) shows no shifted indexicals that might indicate quotation or some other shift to a protagonist context. Everything in (25) is interpreted from the narrator's neutral perspective, all we have here is an intensional operator quantifying over Joe's dream worlds.

In PicDRT we propose that Cautious Update may introduce, instead of a monstrous, *de se* perception operator ($PERC_x$ from (20b)), also a non-monstrous, purely intensional attitude operator (ATT_x). For the blended Simpsons panel in (22)a this results in the output in (26):

[15] (24)a: *Joe the Barbarian*, 2011, Vertigo Comics.

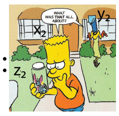
(26) a.

$p_1 \ x_1 \ y_1$

p_1: 

ATT_{x_1}

$p_2 \ x_2 \ y_2 \ z_2$

p_2: 

$x_2 = x_1 \quad y_2 = y_1$

b. $[\![ATT_{x_1}K]\!]^{f,v,w} = 1$ iff for all w' compatible with $f(x_1)$'s attitudinal state in w: $[\![K]\!]^{f,v,w'} = 1$

5. Conclusion

Pictures, like sentences, have truth-conditional content. And sequences of pictures, like sequences of sentences, can be used to tell stories. We introduce PicDRT, a simple extension of standard DRT to analyze pictorial storytelling in a dynamic semantic setting.

The current paper presents a PicDRT case study on attitude and perception reporting in pictorial narratives. First, we briefly suggest that the familiar speech and thought bubbles in modern comics may be thought of as the pictorial analogue of quotation, but we leave a detailed study for future research. We then spend some time reconstructing and adapting ideas from Abusch and Rooth (2017) on free perception sequences in PicDRT. Though closely related, our analysis is more pragmatic in nature than theirs. For non-veridical free perception cases, for instance, we invoke a pragmatic mechanism based on Eckardt's (2014) Cautious Update, introducing a pragmatically inferred *de se* perceptual experience operator. We go on to consider a phenomenon we call blended panels, where a protagonist's mental state may be depicted alongside the experiencing protagonist herself in a single panel. We compared this phenomenon to free indirect discourse in linguistic narrative but concluded that the analogy fails. A blended picture is more like a regular indirect attitude report, i.e. involving an intensional operator but no perspective shift or quotation.

In conclusion, applying the formal semantic toolkit of DRT, and importing insights from the semantic analysis of linguistic attitude reporting and quotation, has helped us better understand certain types of attitude representation in the visual domain. At the same time, the discussion of free perception panels in particular has led us to consider the way we represent perception in linguistic narratives, an area that is quite underdeveloped in formal semantics (Hinterwimmer, 2017 being a notable exception).

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The CommitmentBank:
Investigating projection in naturally occurring discourse[1]

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Abstract. This paper describes a new resource, the CommitmentBank, developed for the empirical investigation of the projection of finite clausal complements. A clausal complement is said to project when its content is understood as a commitment of the speaker even though the clause occurs under the scope of an entailment canceling operator such as negation or a question. The study of projection is therefore part of the study of commitments expressed by speakers to non-asserted sentence content. The content of clausal complements has been a central case for the study of projection, as there is a long-standing claim that clause-taking predicates fall into two classes—factives and nonfactives—distinguished on the basis of whether the contents of their complements project. This claim identifies the embedding predicate as the primary determinant of the projection behavior of these contents. The CommitmentBank is a corpus of naturally occurring discourses whose final sentence contains a clause-embedding predicate under an entailment canceling operator. In this paper, we describe the CommitmentBank and present initial results of analyses designed to evaluate the factive/nonfactive distinction and to investigate additional factors which affect the projectivity of clausal complements.

Keywords: projective content, attitude predicates, factive predicates, corpus annotation.

1. Introduction

To understand the messages conveyed by speakers or writers, we need to recognize which propositions they intend to commit themselves to by their utterances. Most straightforwardly, speaker commitment is indicated by assertion, typically carried out by the utterance of a declarative clause. But of course, the picture is far more complex, because speakers may be understood to be committed to contents which are not asserted. This paper is concerned with the empirical investigation of one particular sub-class of cases where speakers may be understood to be committed to, or to be certain about, non-asserted content. We focus on the contents of finite clausal complements of clause-embedding predicates such as *think, accept, tell* and *know*.

For some clause-embedding predicates, speaker commitment to the content of the complement (CC, henceforth) seems straightforwardly explainable in terms of entailment. It is generally held that sentence (1) entails the CC of *know*.

(1) Jane knows that it is snowing.

As speakers are generally assumed to be committed to the (obvious) entailments of their assertions, a speaker of (1) will be taken to be committed to the claim that it is snowing.

However, as is well-known, speaker commitment to the CC may remain even when the predicate (in our case *know*) is embedded under an entailment canceling operator. In general, speak-

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ers are *not* committed to content which occurs under such an operator, or to its entailments. The entailment canceling environments usually considered are enshrined in the so-called Family of Sentences (see Chierchia and McConnell-Ginet, 1990), illustrated in (2). The standard claim is that utterances of these sentences would typically commit the speaker to the truth of the CC of *know*, even though that content is no longer entailed by the sentence as a whole.

(2) a. Jane doesn't know that it is snowing.
b. Does Jane know that it is snowing?
c. Jane may know that it is snowing.
d. If Jane knows that it is snowing, she will wear her snow boots, hat and gloves.

Content which is expressed under the scope of an entailment canceling operator but which is nonetheless understood to be a commitment of the speaker is said to *project*. Content which has the potential to display this behavior is *projective*. The question of interest in this paper is this: Under what circumstances will the CC of a clause-embedding predicate project?[2]

On standard semantic accounts (e.g., Heim, 1983; van der Sandt, 1992), projection of the CC is a consequence of it being *presupposed*. Exactly what is meant by presupposition varies between different accounts, but all standard accounts agree that projection is a characteristic feature of presupposed contents, so much so that the tendency for content to project is very typically taken as a diagnostic for presuppositionality (but see Chierchia and McConnell-Ginet, 1990 for early articulation of reservations about this diagnostic). In the case of clause-embedding predicates, there is a long-standing view (dating back to Kiparsky and Kiparsky, 1970) that these predicates divide into two classes: factive embedding predicates, which lexically encode presuppositionality of their CCs; and nonfactive embedding predicates, which do not. The contents of factive complements, being presupposed, can project over entailment canceling operators. The contents of nonfactive complements are generally taken to be non-projective.

The factive/nonfactive categorization might seem to make straightforward predictions about projection of CCs. For a variety of reasons, this is an over-simplification. First, there is a long-standing observation that any presuppositional content, including CCs, may fail to project when projection would generate an inconsistency. For example, in the sequence in (3) the speaker cannot be taken to be committed to the CC, as she has just explicitly denied it.

(3) It is not snowing, so of course Jane doesn't know that it's snowing.

Moreover, the classification of a predicate as nonfactive simply carries the claim that its CC will not project by virtue of being presuppositional; it does not follow that there are no discourse circumstances in which that content may project for other reasons. Indeed, the recent literature contains some passing suggestions regarding projective interpretations of complements of non-factives (see Anand and Hacquard, 2014; Schlenker, 2010). Further complicating the picture, Karttunen (1971) suggested that for at least some factives, which he dubbed "semi-factives," the person of the matrix subject or the tense of the matrix predicate might affect whether the complement projects. There are further relevant factors: Tonhauser et al. (2018) found that the projectivity of utterance content, including the CC of factive, semi-factive and nonfactive

[2]We are actually interested in a broader question, that is, the question of when a speaker is understood to be committed to the CC, regardless of the presence of an entailment canceling operator. This is of particular interest in those cases where the embedding predicate does not entail the CC.

predicates, is gradient and that content is more projective the more it is not at-issue with respect to the question under discussion. Tonhauser (2016) found that the prosodic realization of sentences with factive and semi-factive predicates influences the extent to which the complement projects. With these additional factors taken into account, it is clear that the factive/nonfactive categorization can be at best a very partial predictor of projection in actual cases. In fact, as we will argue below, this categorization has very little predictive power (see section 3.1.1).

Our goal with the CommitmentBank has been to create a resource for the empirically-based study of projection of CCs, using naturally occurring examples and basing analysis on judgments of projection provided by theoretically untrained speakers. The ultimate goal of the project is to provide a predictive account of projection of clausal contents. In this paper, we detail the process of creating the CommitmentBank, our methodology for collecting projection judgments, and the further annotations that we have carried out. We also present preliminary results concerning the predictive power of a variety of features of the discourses. The CommitmentBank corpus is available at `https://github.com/mcdm/CommitmentBank`.

2. The CommitmentBank corpus

In this section, we detail how we built the corpus and which annotations have been carried out.

2.1. Data

The CommitmentBank contains 1,200 examples of naturally occurring discourse segments extracted from three corpora of different genres: the Wall Street Journal (WSJ, news articles), the fiction component of the British National Corpus (BNC, fiction) and Switchboard (SWBD, dialogue). Each discourse consists of a target sentence with a clause-embedding predicate embedded under an entailment canceling operator (negation, modal, antecedent of conditional, or question) with up to 2 prior context sentences/turns. Examples are given in (4) and (5), where the target sentence is underlined. The alphanumeric code in brackets after each example is the internal code of the item in the CommitmentBank.

(4) What fun to hear Artemis laugh. She's such a serious child.
I didn't know she had a sense of humor. [BNC-1607]

(5) A: Oh yes. Animals have a way of talking.
B: Alfie did. I tell you if I could have gotten a hold of that cat that day.
A: I don't know uh that I'd trade my dog in for the world. [SWBD-243]

These discourse segments were automatically extracted. First, using the Stanford dependency parser (Klein and Manning, 2003; de Marneffe et al., 2006), we obtained dependency parses for each sentence in the three corpora, and extracted sentences in which a predicate has a clausal complement and the predicate is itself embedded under negation or a modal, or in a question or the antecedent of a conditional. To guarantee accuracy of the samples, the results were manually curated. The 1,200 examples represent 48 different clause-embedding predicates. Table 1 shows the number of discourses for each predicate, by embedding environment.

Predicate	Conditional	Modal	Negation	Question	Predicate	Conditional	Modal	Negation	Question	Predicate	Conditional	Modal	Negation	Question
accept	0	0	1	1	forget	0	4	7	2	recognize	0	0	1	0
admit	1	3	1	1	guarantee	0	2	0	0	remember	1	4	2	0
announce	1	1	0	1	guess	0	6	9	5	see	1	27	10	1
assume	1	7	1	2	hear	2	5	3	1	seem	0	0	2	0
believe	5	19	40	10	hope	0	17	1	2	say	21	40	39	14
bet	0	0	0	1	hypothesize	0	0	0	1	show	0	2	0	0
bother	0	0	1	0	imagine	2	14	12	1	signal	0	1	0	1
convince	0	3	4	0	insist	2	1	0	2	specify	0	1	0	0
decide	3	8	0	0	know	18	16	78	21	suggest	4	3	11	1
demand	0	1	1	0	learn	2	0	2	2	suppose	2	3	2	1
expect	0	1	4	0	mean	4	14	27	7	suspect	5	11	4	0
fear	2	1	0	0	notice	1	7	23	3	swear	0	1	0	0
feel	4	8	16	6	occur	0	0	1	0	take	0	0	0	1
figure	1	0	0	0	pretend	0	2	2	2	tell	6	21	7	4
find	6	9	1	5	prove	0	4	1	0	think	21	39	265	61
foresee	1	0	0	0	realize	0	3	20	6	understand	0	4	4	1

Table 1: Number of discourses by predicate in each embedding environment.

2.2. Projection (speaker commitment) annotations

In order to determine in each discourse segment whether the CC projects, we must determine whether interpreters judge the speaker of the target sentence to be committed to that content. We operationalize this by asking how certain the speaker/author is that this content is true. For each discourse segment, we elicited such judgments from at least eight self-reported native English speakers, using a questionnaire created on Amazon's Mechanical Turk Platform. (The elicitations were performed with IRB approval; distribution was restricted to IP addresses in the United States. Annotators were paid $1.00 for completing a questionnaire.)

Figure 1 shows an annotation task. The discourse is displayed, with a proper name in bold face identifying the implied speaker (or with speaker A/speaker B for the Switchboard dialogues). Annotators are asked for a judgment about the certainty of the speaker with respect to the CC. They respond on a Likert scale labeled at 3 points (+3/speaker is certain that the CC is true, 0/speaker is not certain whether the CC is true or false, -3/speaker is certain that the CC is false). We follow, i.a., Tonhauser (2016) and Tonhauser et al. (2018) in using the 'certain that' diagnostic to tap into annotators' judgments of speaker commitment, but we have altered the scale to allow annotators to indicate a judgment that the speaker is committed to the negation of the CC. While the issue of "counterfactivity" has been largely neglected in the theoretical literature, it is just as important, from a natural language processing perspective, as the issue of factivity. For information extraction, for instance, it is important to recognize that in (5) above, the speaker is committed to **not** trading in their dog.

Each questionnaire contained eight discourses of interest and two constructed control dis-

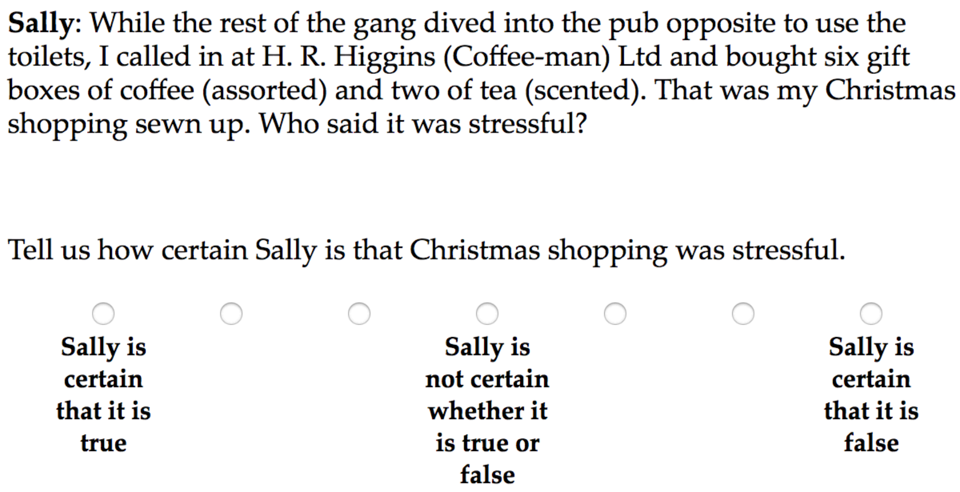

Figure 1: Item display for projection annotation on Mechanical Turk.

courses used to assess annotators' attention. In each questionnaire, one control discourse clearly indicated speaker certainty that the CC is true (6), while the other clearly indicated speaker certainty about the negation of the CC (7). For the "true" control items, we accepted responses of +2 or +3; for the "false" ones, we accepted responses of -3 and -2. Data from annotators who gave other responses to at least one control item was excluded from analysis.[3]

(6) **John**: Tess was our star in the marathon this year. She's always trained with all her heart and soul. After all that training, she was happy to cross the finish line.
Prompt: Tell us how certain John is that Tess crossed the finish line.

(7) **A**: Did you hear anything about Olivia's chemistry test?
B: Well, she studied really hard. But even after putting in all that time and energy, she didn't manage to pass the test.
Prompt: Tell us how certain speaker B is that Olivia passed the test.

The complements *p* in the prompt to the annotators (*Tell us how certain the speaker is that p*) were manually constructed from the discourses to ensure that pronouns and temporal references were correctly resolved. For instance in (4), the complement is *she had a sense of humour*, but the pronoun *she* is resolved to *Artemis* in the prompt. We discarded discourses where the target sentence but not the context was contained in a direct quote (as in (8), as here the speaker of the target sentence is not the same as the speaker of the context). In addition, we discarded a wide variety of other cases where it was difficult to construct a brief and accurate paraphrase of the CC.[4] Example (9) shows a case where the clausal complement of *prove* contains a bound pronoun (*drug makers/their pill*), making paraphrase of this content impossible. We also discarded discourses where the automatic extraction was erroneous. Overall, we discarded 60% of the data extracted from WSJ, 70% of the data from the BNC, and 40% for SWBD.

(8) The small increase in the index of leading indicators, which had climbed 0.5% in August but was unchanged in July, does lend support to the view that the economy has

[3]All control items we used can be found online, at `https://github.com/mcdm/CommitmentBank`.
[4]These examples raises the question of how, as theorists, we should discuss or evaluate projection in such cases.

slowed noticeably. However, it doesn't give much of a clue as to whether a recession is on the horizon. "I don't think it provides much new information on the economy," said Richard Rippe, economist at Dean Witter Reynolds Inc.

(9) But courts quickly tumbled down a slippery slope. Just as all plaintiffs are not alike, it turns out that DES defendants marketed the drugs differently and may have offered different warranties. The ultimate result came in Hymowitz v. Lilly, where the highest New York court expanded the market-share approach for the first time to say that drug makers that could prove Mindy Hymowitz's mother didn't use their pill must still pay their share of any damages.

2.3. Person and number of the subject of the clause-embedding predicate

We automatically annotated the person of the subject of the predicate. The subject of the predicate is found using the dependency graph, and its person and number are assigned using heuristics based on its lemma and part-of-speech tag. Person is "first", "second" or "third". Number is "singular", "plural", or "unknown" in the case of a "you" subject. We are currently manually annotating whether a "you" subject is impersonal or not.

2.4. Temporal reference of the matrix clause

The temporal reference of the matrix clause of each target sentence was manually annotated, as "present" (time of utterance is included in the temporal reference of the matrix clause), "past" (temporal reference of the matrix clause fully precedes time of utterance) or "future" (time of utterance fully precedes the temporal reference of the matrix clause). Manual annotation was required because temporal reference was not straightforwardly determinable from tense marking. The annotation was carried out by native speakers of English based on their intuitions about intended temporal reference.

2.5. Modality

The standard Family of Sentences used to diagnose projection includes embedding of content under an epistemic possibility modal. As noted, we automatically extracted sentences including possibility modals (including *could*, *may*, *might*, *probably*, *possibly*, *maybe*, *possible*, *probable*, *perhaps*). However, many of these can be used to signal multiple types of weak modality. In order to enable us to restrict analyses to just those cases involving the standard epistemic case, we manually annotated each modal item using the following categorization:

Epistemic: The modal expresses speaker uncertainty about whether an event did or will happen. It is an expression of the speaker's evaluation of the possibility of the event, as in (10).

(10) Like now. The Community in Knockglen would defend Eve vociferously. Even some of the Sisters here in Dublin might see that the girl had a point. [BNC-1074]

Ability: The modal pertains to the ability of the subject to do something, as in (11).

(11) The car engine roared again and the red car moved off but it didn't go far. Stuart's Mum was reversing out of her space and her car was blocking the way. Stuart could see that the red car was going to turn back. [BNC-1069]

Deontic: The modal is an expression of permission, as in (12).

(12) Nick rolled his eyes upwards. "Not so bad then." She wished she could tell him that Mr Evans hadn't stolen the Will after all but Nick had never thought that he had so there was no point in it. [BNC-1158]

Circumstantial: Circumstantial modality concerns what is possible or necessary given a particular set of circumstances, as in (13). This covers a wide range of cases. In practice, if a modal did not fit any of the above three categories, the Circumstantial label was used.

(13) It was a complex language. Not written down but handed down. One might say it was peeled down. [BNC-1015]

2.6. Plausibility of the CC given the context

In some cases, the speaker of a discourse may be judged certain about the CC (or its negation) based on information contained in the preceding discourse (as in (14), where the existence of the Toacks is entailed by the first sentence) or based on world knowledge (as in (15), where credit card number is known to be sensitive information).

(14) The English read: IT IS FORBIDDEN TO CROSS THE TOACKS. That summer I came to know the Toacks—with their roots hooked under the earth's crust. On the right side of them you'd never guess they even existed but from where I was they were too deep to fathom and too tall to cross. [BNC-1450]

(15) But what we may not know is just what makes somebody a sucker. What makes people blurt out their credit-card numbers to a caller they've never heard of? Do they really believe that the number is just for verification and is simply a formality on the road to being a grand-prize winner? [WSJ-31]

To evaluate the role of information external to the target sentence in projection, we carried out an annotation task in which we collected certainty ratings about the CC in the absence of the target sentence. We used the same task as described in Section 2.2, but presented annotators with only the context sentences, *without* the target sentence. For instance, for the discourse presented in Figure 1, annotators would see exactly the same prompt, but without the last sentence of Sally's utterance, *Who said it was stressful?*, and were asked the same question ("How certain is the speaker that Christmas shopping was stressful?"). As before, judgments of annotators who did not answer as expected on control items were discarded. Such annotations have been obtained for 558 discourses from the WSJ and the BNC. We assume that these annotations are a proxy for the plausibility of the CC given the context.

3. Analysis of factors explaining projection

We use the CommitmentBank to analyze several factors put forth in the literature as having some role in projection and to quantitatively assess their contribution to projection, first independently and then combining them. The analyses were carried out on a slightly restricted

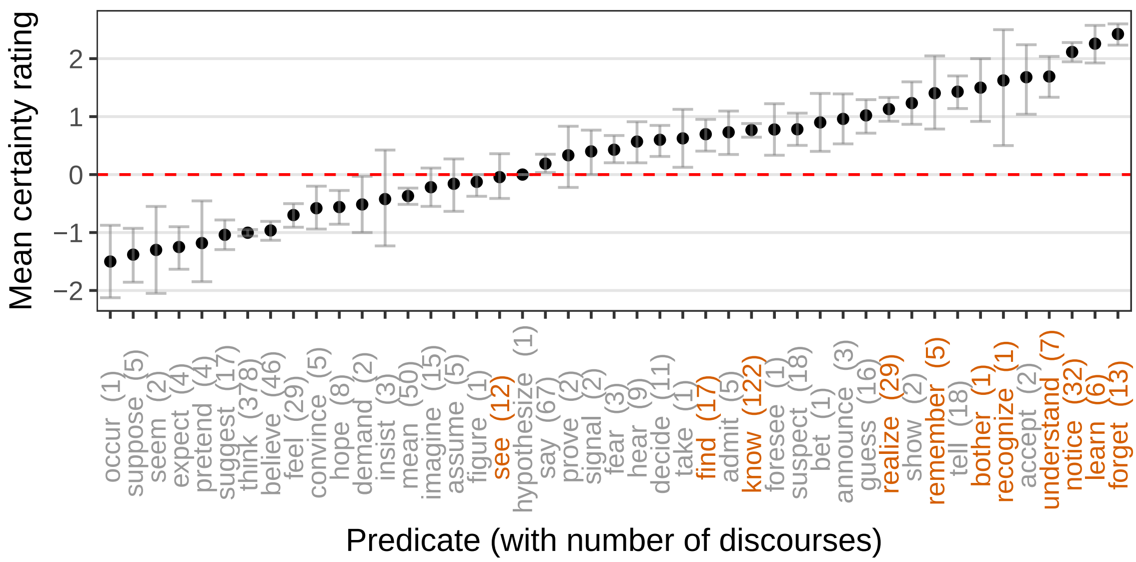

Figure 2: Mean certainty ratings for CCs, by predicate, restricting modal environment to epistemic modals. Number of discourses in parentheses. Error bars indicate bootstrapped 95% confidence intervals. Purported factive predicates are in orange, nonfactive predicates in gray.

subset of the data. As noted above, our data includes clause-embedding predicates occurring under a variety of weak modals. The standard literature, however, only considers weak epistemic modals as providing a diagnostic for projection. In order to ensure that we are analyzing CCs which, on standard views, have the potential to project, we eliminated examples with non-epistemic modals from analysis. The resulting dataset consists of 982 discourses (100 from WSJ, 461 from BNC, 421 from SWBD), with 45 different clause-embedding predicates.[5]

3.1. Evaluating the role of the predicate

The first factor we consider is the predicate. Figure 2 shows the mean certainty ratings for all items by predicate, arranged in order from lowest mean certainty rating (reflecting judgments that the speaker is certain that the CC is false) to highest mean certainty rating (reflecting judgments that the speaker is certain that the CC is true). Factive predicates are shown in orange.[6] We observe by-predicate variability: for instance, the mean certainty rating for *occur* is lowest, at -1.5, whereas the mean certainty rating for *forget* is highest, at 2.43. We now consider how classifying predicates as factive/nonfactive contributes to the projectivity of the CC, and then consider how individual predicates contribute.

[5]Compared to Table 1, the following three verbs are not present in the restricted dataset: *guarantee*, *swear*, *specify*.
[6]The verb *see* has been noted to have an evidential use in which the CC does not routinely project over entailment canceling operators. We hand checked the *see* examples in this subset of the data and determined that none involved an evidential use of the type identified in, e.g., Simons (2007).

3.1.1. Factivity

As discussed in the introduction, two classes of clause-embedding predicates are standardly distinguished: factives, which signal that the CC is presupposed, and hence projective; and nonfactives, which do not signal anything about the CC. The CommitmentBank includes both types of predicates; the factive verbs found in CommitmentBank are listed in (16):

(16) *bother, find, forget, know, learn, notice, realize, recognize, remember, see, understand*

On a simplistic interpretation, the standard view—projection is a consequence of presupposition, and presupposition is determined by the embedding predicate—leads us to expect that all items with factive predicates will be judged highly projective (i.e., receive high speaker certainty ratings), while items with nonfactive predicates will have certainty ratings around zero. In other words, whether the predicate is factive or not should be a strong predictor of projectivity.

Figure 2 shows a picture not entirely out of line with the predictions of this simple interpretation: there is indeed a clustering of factive predicates at the right hand side of the graph. However, there is no clean separation of factive and nonfactive predicates: some of the nonfactive predicates have higher mean certainty ratings than some factives, with *know*—perhaps the most cited example of a clearly factive verb—relatively low compared with others in that class. Nonetheless, the CC of *know* is still overall judged projective, as predicted by the standard account. Note that our results confirm the claims of Anand and Hacquard (2014) and Schlenker (2010) mentioned above, that at least some nonfactive predicates can give rise to projection.

The impression created by Figure 2 that semantic factivity is a predictor of projection, albeit a weak one, is confirmed by an ordinal mixed-effects model[7] predicting the certainty ratings from a fixed effect of 'factivity' (a binary factor indicating whether the predicate is in the list in (16), with 'nonfactive' the reference level). The model included random by-annotator intercepts (capturing differences in projectivity between annotators). The coefficient (β) for 'factivity' is positive (β = 1.60, SE = 0.05, z = 34.69, $p < 0.001$), indicating, as expected, that overall the CCs of factive predicates received higher certainty ratings than those of nonfactives, i.e., are more likely to project. However the Nagelkerke R^2 of this model is similar to a model which uses the person of the subject of the predicate as fixed effect (0.126 vs. 0.124). Nagelkerke R^2 is a measure of goodness of fit of the model, which can be thought of as quantifying how much of the variance in the data is captured by the model: an R^2 of 0 means that the model does not account for any of the variance in the data, whereas 1 indicates a perfect fit. In other words, the person of the matrix subject accounts for the same amount of variance in the data as the traditional characterization of a predicate as factive or nonfactive. (We return to the contribution of person in section 3.2.)

Of course, theories that account for projection in terms of lexically encoded presupposition allow for the absence of projection in particular cases involving factive predicates. Advocates of such accounts might propose additional pragmatic accounts of the fact that theoretically untrained speakers appear to treat projection as a gradient rather than a binary feature. Also, as we have already noted, standard analyses do not rule out projection of the CCs of nonfactive

[7] We used the `ordinal` package (version 2018.8-25, Christensen, 2018) in R (version 3.5.0, R Development Core Team, 2016).

Factor	Nagelkerke R^2
Genre	0.062
Predicate tense	0.078
Embedding	0.091
Person of predicate subject	0.124
Factivity	0.126
Predicate lemma	0.228

Table 2: Nagelkerke R^2 of ordinal mixed-effects models, predicting certainty ratings of the 982 discourses, from 'Factor' as fixed effect and random by-annotator intercepts.

predicates, but only requires that this projection be accounted for without invoking lexically encoded presuppositionality. Nevertheless, the patterns of projection judgments in the CommitmentBank raise a question about how the binary, categorical distinction between factives and nonfactives is to be drawn. Kiparsky and Kiparsky (1970) originally distinguished factives from nonfactives on the basis of a range of syntactic and semantic/pragmatic observations, including but not limited to judgments of projection. But currently, factives are standardly distinguished from nonfactives on the basis of the projectivity of the CC and whether the CC is entailed (e.g., Gazdar, 1979; Chierchia and McConnell-Ginet, 1990; Schlenker, 2010; Anand and Hacquard, 2014).[8] The judgments on which the distinction rests are generally those of theorists considering extremely simple sentences like those in (2), considered without any context. But is the binary, categorical distinction between factives and nonfactives supported by more rigorous testing? A first challenge comes from Tonhauser et al.'s (2018) finding that there is significant variability in how projective the CCs of factive predicates are: the CC of *discover*, for instance, was significantly less projective than that of *know*.

A further challenge comes from the naturally occurring discourses of the CommitmentBank. By modifying the aforementioned model, we can quantify the degree to which the projection behavior of each predicate differs from that predicted by its factive/nonfactive categorization. This is done by adding random by-predicate intercepts (capturing differences in projectivity between predicates) to the ordinal mixed-effects model which predicts the certainty ratings from the fixed effect of 'factivity' (now: β = 1.57, SE = 0.30, z = 5.32, $p < 0.001$). Table 3 gives the random effect coefficients for each predicate. These values tell us how the intercept for each predicate needs to be adjusted: positive coefficients mean that the predicate leads to higher certainty ratings than is predicted by its factive/nonfactive classification, and negative coefficients mean that the predicate leads to lower certainty ratings. For instance, the CCs of *know* and *realize*, with negative coefficients, are less projective than the overall mean projectivity of the factive CCs. On the other hand, the CCs of *accept* and *tell*, with positive coefficients, project more than the CCs of other nonfactive predicates. The variability observed between the coefficients of factive predicates suggests that the projection behavior of factive predicates is more heterogeneous than assumed and, hence, may challenge the assumption that the factive/nonfactive distinction is central to understanding projectivity.

[8]Kiparsky and Kiparsky (1970) did not require factives to entail the CC.

Predicate	Coef.	Predicate	Coef.	Predicate	Coef.	Predicate	Coef.
accept	1.48	feel	-0.62	**learn**	0.92	show	0.94
admit	0.57	figure	0.11	mean	-0.33	signal	0.30
announce	0.83	**find**	-0.84	**notice**	0.75	suggest	-0.98
assume	-0.10	foresee	0.70	occur	-0.77	suppose	-1.28
believe	-0.99	**forget**	1.20	pretend	-1.25	suspect	0.71
bet	0.71	guess	1.01	prove	0.19	take	0.42
bother	-0.18	hear	0.51	**realize**	-0.34	tell	1.48
convince	-0.40	hope	-0.44	**recognize**	0.13	think	-0.87
decide	0.49	hypothesize	0.19	**remember**	0.24	**understand**	0.23
demand	-0.38	imagine	-0.19	say	0.20		
expect	-1.10	insist	-0.43	**see**	-1.44		
fear	0.29	**know**	-0.71	seem	-0.96		

Table 3: Random effect coefficients for each predicate in an ordinal mixed-effect model with 'factivity' as fixed effect and random by-predicate and by-annotator intercepts. Predicates assumed to be factive are in bold.

3.1.2. Predicting projection from predicate lemma

Figure 2 showed that there is between-predicate variability in the projectivity of the CC. Here we consider a second way in which the predicate may be taken to contribute to the projectivity of the CC. Specifically, we consider an ordinal mixed-effects model in which the certainty ratings are predicted from a fixed effect of predicate lemma (with *accept* as the reference level and treatment coding) and random by-annotator intercepts. The last row of Table 2 gives the Nagelkerke R^2 of the model: 0.228. This model thus captures more variation than the model which uses semantic factivity as a fixed effect. This is not totally surprising, given that semantic factivity is a coarse-grained binary classification of the predicates and given that there is significant projection variability between factive predicates (Tonhauser et al., 2018). In the context of these observations, the CommitmentBank data suggests that properties of individual predicates are of greater predictive value with respect to projection than the factive/nonfactive distinction, and so call for a careful analysis of the lexical properties which affect projection. We also note, however, that the Nagelkerke R^2 of 0.228 indicate that there is still a lot of variance in the data that the model does not capture. We consider some other factors below.

3.1.3. Between-item and between-annotator variability

The previous sections showed that there is between-predicate variation, even within the classes of factive and nonfactive predicates. Our results show variation along two further dimensions: between the items of predicates and between annotators (see also Tonhauser et al., 2018). As illustration of between-item variation, consider Figure 3, which shows the mean certainty ratings for each item with *know*, *believe* and *tell*. As is evident, the CC of none of these predicates has a uniform projection profile: certainty ratings are highly item-sensitive, for both the canonical factive *know* and the nonfactives *believe* and *tell*.

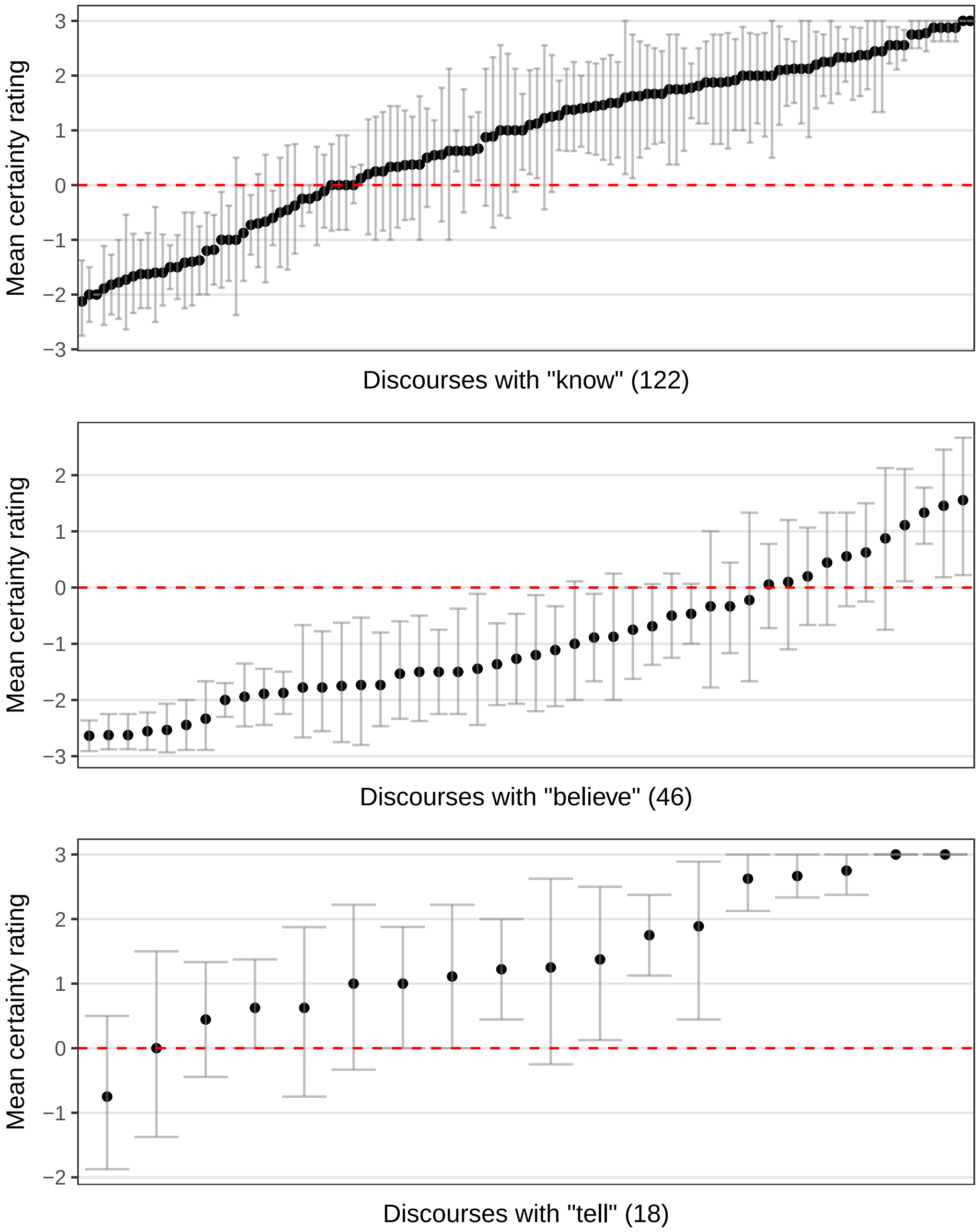

Figure 3: Mean certainty ratings for CCs of *know*, *believe* and *tell*. Number of discourses in parentheses. Error bars indicate bootstrapped 95% confidence intervals.

The examples in (17) illustrate the contrasts between discourses for which the CC was highly projective (17a, 17c) and discourses for which the CC was not projective (17b,17d).

(17) a. At the heart of the universe there is cruelty. We are predators and are preyed upon every living thing. Did you know that wasps lay their eggs in ladybirds piercing the weak spot in their armour? [BNC-2375, mean: +3]

b. "Rather a long shot wasn't it? Twenty years? How do you know the baby was born here?" [BNC-2394, mean: -0.25]

c. The Susweca. It means "dragonfly" in Sioux you know. Did I ever tell you that's where Paul and I met? [BNC-2630, mean: +3]

d. His reaction to the news had been partly predictable and partly complex and more disturbing. There had been the natural initial shock of disbelief at hearing of the unexpected death of any person even casually known. He would have felt no less if he'd been told that Berowne was dead of a coronary or killed in a car smash. [BNC-428, mean: -0.75]

The plots in Figure 3 illustrate that in addition to between-item variability, there is also between-annotator variability: large confidence intervals indicate that annotators vary in their ratings. Examples (17a) and (17c) are cases where there was no such variability: all annotators judged the speaker to be certain that the CC is true (+3). But in other examples, there was variability in the certainty ratings. In (18), 5 annotators said 0, 3 annotators replied negatively -1, -2 and -3, and 4 annotators replied positively (2 saying +1 and 2 saying +2).

(18) A: Yeah I had a friend whose brother did steroids and as soon as he stopped working out he just ballooned out. It all turned to fat and he just really looked bad.
B: Really. Ugh. I didn't know it did that. [SWBD-251]

In (19), all annotators replied negatively, but in different degrees: 2 replied -3, 4 said -2 and 2 replied -1.

(19) B: It's just a great cat but.
A: Well my personal preference is a dog. Uh I don't know uh that I would ever want a cat. [SWBD-114]

In roughly a third of the 982 discourses, annotators agreed on whether the CC projects but disagreed in the degree of (non)projection, as in (19). In two thirds of the discourses, some annotators gave projecting and others gave non-projecting responses. Between-annotator variation in our naturally occurring items is in line with the findings of Tonhauser et al. (2018), who also found that participants gave significantly different certainty ratings.

In summary, we have found, unsurprisingly, that knowing the identity of the embedding predicate contributes positively to predictions of projection, but a great deal of additional information is also required. Knowing the categorization of the predicate as factive or nonfactive, however, has comparatively less predictive power.

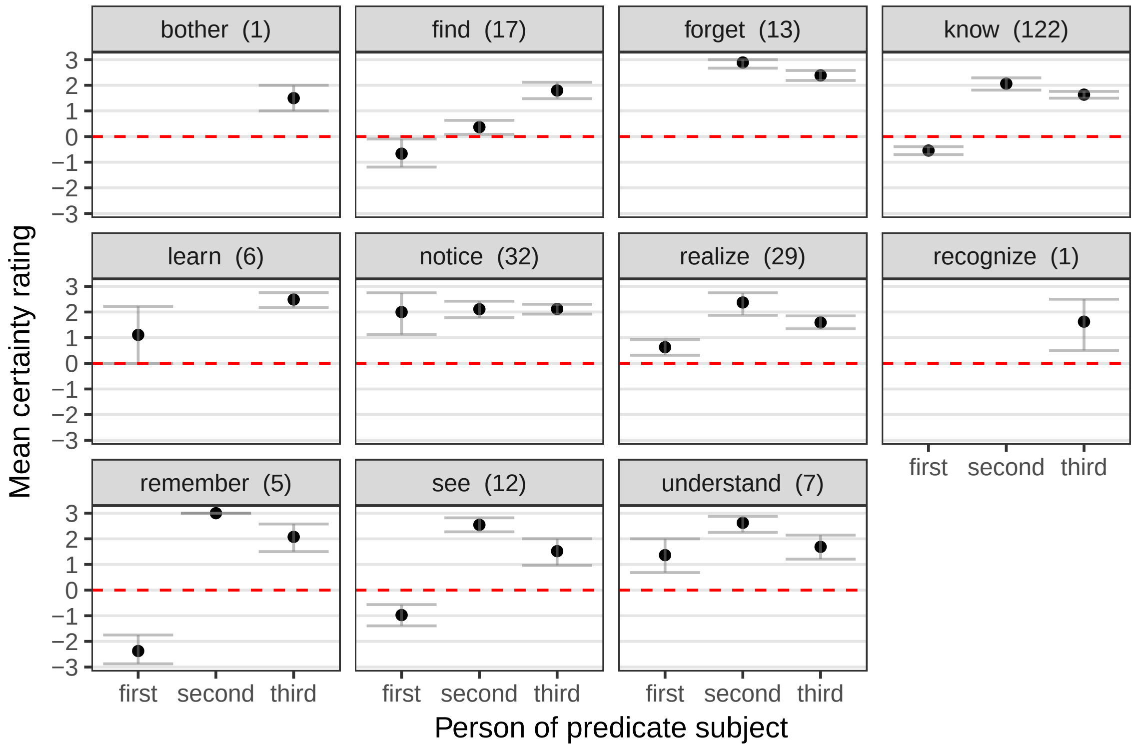

Figure 4: Mean certainty ratings for CCs by person subject of factive predicates. Number of discourses in parentheses. Error bars indicate bootstrapped 95% confidence intervals.

3.2. Subject and tense of the predicate

There are claims in the literature on factives that the person of the subject of the factive predicate may affect whether or not the CC projects (i.a., Karttunen, 1971; Gazdar, 1979; Stalnaker, 1974). The effect of person can be illustrated by pairs such as (20) and (21):

(20) If I discover that the data has been falsified, I will report it to the authorities.

(21) If he discovers that the data has been falsified, he will report it to the authorities.

While (21), considered with no additional context, suggests that the speaker believes that the data has been falsified, this implication is absent in (20). Stalnaker (1974) offers a pragmatic account of this difference. Beaver (2010), providing a much more thorough discussion of effects of person based on naturally occurring data, also argues, on the basis of careful examination of individual cases, that the effects of person are essentially pragmatic, and interact with additional factors in determining presence or absence of projection. The CommitmentBank provides a further resource for such examination of specific cases, but here we will ask a more global question: to what extent is the person of the factive subject a predictor of projection?

Figure 4 plots the mean ratings per person for all 11 factive predicates in the data. For most predicates, the CCs of predicates with first person subjects are associated with lower certainty ratings than those of predicates with non-first person subjects.

As noted above, the person of the predicate subject captures as much variance as the factivity

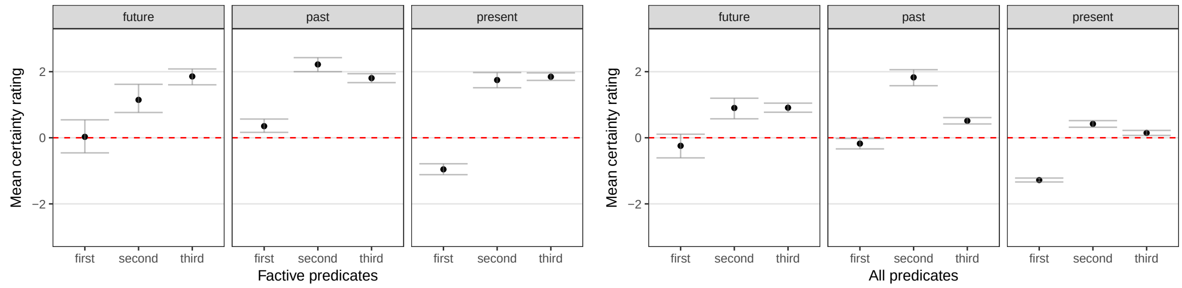

Figure 5: Means certainty ratings by tense and subject person, for CCs of factives on the left, for CCs of all predicates on the right. Error bars indicate bootstrapped 95% confidence intervals.

classification. Table 2 revealed that the tense of the predicate alone only captures a trivial amount of variance (0.078). But the CommitmentBank data suggests that there is an interaction between the tense of the predicate and the person of the subject, as previously proposed in the literature. The left panel of Figure 5 shows the certainty ratings by tense and subject person for the CCs of factive predicates. A similar picture emerges for all predicates, but with lower ratings overall, as shown in the right panel of Figure 5. Log-likelihood comparisons of an ordinal mixed-effects model with fixed effects for tense and person, and their interaction, and a model without the interaction confirm that the interaction is significant ($p < 0.001$). This is true for models fitted to the factive predicates and models fitted to all predicates. (All models included random by-annotator intercepts.) This observation raises the question of whether separate projection analyses for factive and nonfactive predicates are empirically justified.

In summary, our results indicate that information about person of the subject and tense of the predicate are relevant, if small, factors in predicting projectivity for examples in context.

3.3. Embedding and genre

Karttunen (1971) pointed out that for at least some factive predicates, projection may differ across entailment-canceling environments. For example, he notes that when *discover*, *find out* and *see* occur in a question, the CCs do not necessarily project: he observed that (22) "can also be understood as a sincere request for information. The speaker is not sure about the truth of the complement and is prepared to accept the addressee's discovery as a fact" (p.63).

(22) Did you discover that you had not told the truth?

There has also been some experimental evidence suggesting that embedding environments lead to different projection behavior. In particular, Smith and Hall (2014) investigated projection under negation and antecedent of a conditional, finding a difference in degree of projection for the CC of *know* (projecting more under negation than under the antecedent of a conditional).

Figure 6 illustrates that embedding environments might indeed lead to different projection behavior. The much lower certainty rating for negation in SWBD is probably due to a high proportion of discourses with *believe* and *know* in the first person which receive a Neg Raising reading, such as (5) above, or (23) for which all annotators interpret the speaker to be committed to the negation of the CC (all 8 annotators gave -2).

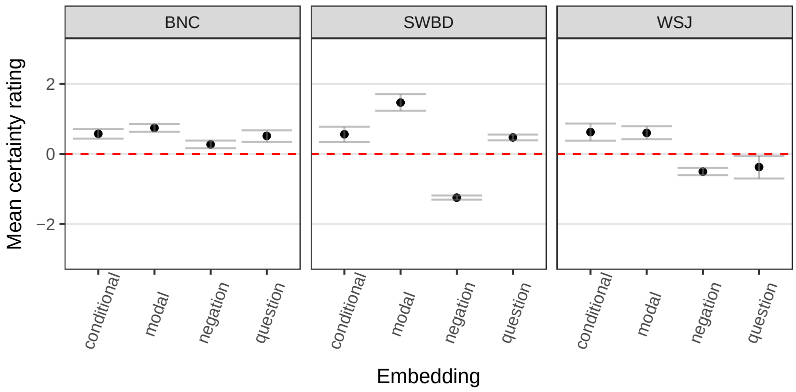

Figure 6: Mean certainty ratings for CCs of all predicates, by embedding and genre. Error bars indicate bootstrapped 95% confidence intervals.

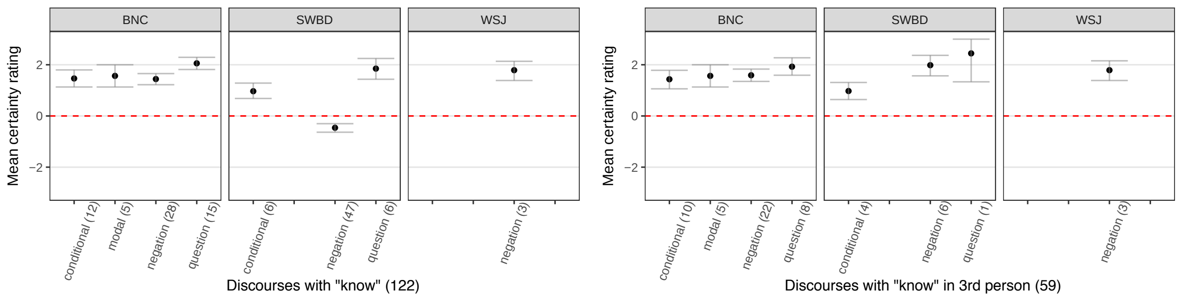

Figure 7: Mean certainty ratings by embedding and genre, for CCs of *know* on the left panel, and for CCs of *know* in the third person on the right. Error bars indicate bootstrapped 95% confidence intervals.

(23) A: but at the same time I think it would do them a world of good.
B: Yeah.
A: But there's a
B: I don't know that you could require everyone yeah to do it for a whole year or two years or something like that. [SWBD-245]

Figure 7 concentrates solely on *know*: the left panel plots all 122 discourses with *know*, the right panel concentrates on discourses in the third person (59 discourses). As can been seen, when restricting the data to third person discourses, discourses under negation in SWBD project more, but there still appears to be an effect of embedding. Table 2 suggests that genre and embedding capture only a small amount of the variance in the data. More experimental evidence is needed to fully understand the impact of embedding and genre on projection.

3.4. Plausibility of the CC given the context

Tonhauser et al. (2018) hypothesized that the prior plausibility of the CCs influences projectivity. The mean plausibility ratings of the CCs (see Section 2.6) give an indication of whether there is contextual information in favor of the truth of the CC (positive mean) or the falsity of the CC (negative mean), or whether the context is uninformative regarding the CC (mean around 0). In the 558 WSJ and BNC discourses for which we have such annotations, 9% have a mean smaller or equal to -1, 74% a mean between -1 and 1, and 17% a mean equal to or above 1. We fitted an ordinal mixed-effects model that predicted the certainty ratings for the target sentences from these plausibility means (for the 558 BNC and WSJ discourses). The Nagelkerke R^2 of this model is low, at 0.036, probably because for most items (74%), there is no contextual information against or in favor of the truth of the CC.

The CommitmentBank data and the annotations for the plausibility of the CC given the context allow for further analyses. Which predicates are used to embed the complement in the target sentence of cases where the context or the CC already prime projection? In which cases does the full target sentence alter the certainty ratings compared to the ones obtained when not seeing the target sentence? We leave these questions for future research.

3.5. Summary analyses

In the previous sections, we examined several factors which have been claimed to be relevant to projection of CCs, and assessed their individual contributions to explaining projection behavior. Unsurprisingly, a model with predicate as fixed effect accounts for more variation in the data than any other, including a model with factivity as fixed effect. We now bring all of the factors together into a single model. We fitted an ordinal mixed effects model that predicts the certainty ratings from fixed effects of embedding and genre, and their interaction, as well as tense and person, and their interaction, and the predicate lemma. We again included random by-annotator intercepts. (More complex models did not converge.) All of the fixed effects were significant ($p < 0.001$), as established by log-likelihood model comparisons. This finding confirms claims in the theoretical literature that these factors play a role in projection. However, the model still only has a Nagelkerke R^2 of 0.35 (if we replace predicate lemma by factivity, the Nagelkerke R^2 is 0.29). We also fitted a variant of this model which includes the plausibility means of the CCs as a fixed effect, for the 558 BNC and WSJ discourses for which we have such annotations. In that model, genre is not a significant factor (the certainty ratings for BNC and WSJ discourses do not differ much). The Nagelkerke R^2 of the model is 0.31 (if we replace predicate lemma by factivity, the Nagelkerke R^2 is 0.24). These findings suggest that there is more variability in the data to be accounted for.

Overall, the picture that arises from the CommitmentBank suggests that an account of projectivity requires the integration of many factors. For theorists and those with practical concerns who are interested in predicting whether, in a given utterance, the CC will be understood as a commitment of the speaker, there is clearly more work to be done in uncovering the detailed features of contexts and utterances which contribute to this evaluation.

4. Conclusion

We presented a new resource, the CommitmentBank, for studying projection behavior of the contents of complements of clause-embedding predicates in naturally occurring data. Our main finding is that there is significant variability in projection judgments in such data. An empirically adequate theory of projection will need to identify and incorporate the factors that contribute to that variability. The CommitmentBank can be used to continue to investigate factors that have been hypothesized to impact projection, such as the question under discussion and information structure. We are currently annotating the data for additional pragmatic factors that might play a role in projection, including coherence relations between the target sentence and the context. More analyses of the CommitmentBank will shed light on the linguistic and extra-linguistic factors at play in projection, and we hope that the data will be used as a testbed for future theories of projection.

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Towards a unified account of degree achievements and change of location verbs: the case of Spanish verbs with *en-*[1]

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Abstract. This paper discusses Spanish verbs that are prefixed with *en-*, e.g., ***en-****suciar* 'to dirty' and ***en-****carcelar* 'to jail' (the former is a degree achievement and the latter is a change of location verb). The aim of this paper is to make explicit what the parallels between both kinds of verbal predicates are and provide a semantics that captures these parallels. To this end, I propose that the prefix *en-* has a core meaning, which is based on the locative preposition *en* in Spanish (which roughly translates in English as 'in/inside, on') that can be used in the domain of degrees (in the case of degree achievements) and space (in the case of change of location verbs). My account makes an initial attempt to bridge two different domains focusing on verbal predicates of change. This proposal is, in principle, extensible to (at least) other Romance languages, which display a similar pattern.

Keywords: degree achievement, change of location, base predicate, preposition, Spanish.

1. Introduction

This paper discusses Spanish verbs that are prefixed with *en-*. Verbs derived with *en-* are either degree achievements or change of location verbs. The former is exemplified in (1), a sentence that conveys the meaning that the theme increases in the degree to which it is dirtied. The latter is exemplified in (2), a sentence that conveys the meaning that the theme changes from not being in jail to being in it.

(1) a. **en-**suciar 'to dirty'
    b. Tania **en-**sució la mesa.
       Tania **en-**dirtied the table
       'Tania dirtied the table.'

(2) a. **en-**carcelar 'to jail'
    b. Daniel **en-**carceló a Gianfranco.
       Daniel **en-**jailed Gianfranco
       'Daniel jailed Gianfranco.'

This paper aims to make explicit what the parallels between degree achievements, as in (1), and change of location verbs, as in (2), are and provide a semantics that captures these parallels. This attempt is empirically motivated by the fact that both degree achievements and change of location verbs, as exemplified in (1)-(2), display the same derivational morphology, namely, they are derived by means of the prefix *en-*.

I propose that the prefix has a core meaning that can be used in the domain of degrees and the domain of space. The core meaning of *en-* will be grounded in the well-documented parallels between the prefix *en-* and the locative preposition *en*, which can be roughly translated as 'in/inside, on'. My account thus proposes an initial attempt to shorten the gap between two different domains in semantics focusing on verbal predicates of change, a task that has not

[1]I would like to thank Jon Gajewski for his constant feedback. I would also like to thank the XVIII ALFAL and Sinn und Bedeutung 23 audiences for helpful comments. All errors remain my own.

been undertaken thus far to the best of my knowledge—see Gärdenfors and Warglien (2012) and Krifka (2012) for approaches motivated by the same spirit of bridging different domains in formal semantics. The proposal developed here is, in principle, extensible to other languages, in particular, to other Romance languages where a similar phenomenon is attested—see Gehrke (2008) and references therein for relevant discussion.

The paper is organized as follows; in section 2, I discuss degree achievements with *en-*. In section 3, I address change of location verbs with *en-*. In section 4, I discuss the parallels between the prefix *en-* and the preposition *en* in order to motivate the prepositional nature of the prefix. Section 5 formalizes my proposal. Section 6 is the conclusion.

2. Degree achievements with *en-*

This section discusses degree achievements with the prefix *en-*. I will first introduce the (intuitive) meaning they convey and will then turn to the base predicates that are present in degree achievements with *en-*, which are gradable.

2.1. General meaning

Degree achievements with *en-* convey the meaning that the theme undergoes a change in that it increases in the degree to which the property meaning of the base predicate applies to it. In this sense, the degree achievements under discussion are very similar to what has been reported for English in, e.g., Dowty (1979), Abusch (1986), Hay et al. (1999), Winter (2006), Kennedy and Levin (2008), Pedersen (2015), among others. I provide two (additional) examples below—the translations provide the English sentences, which, as mentioned, convey a rather similar meaning when compared to the Spanish ones. In (3), the theme, the hair, changes in such a way that it increases in curliness; in (4), the theme, the chickens, increases in fatness.

(3) a. **en-**crespar 'to curl'
    b. Meloddye **en-**crespó el cabello.
       Meloddye **en-**curled the hair
       'Meloddye curled the hair.'

(4) a. **en-**gordar 'to fatten'
    b. Tania **en-**crespó los pollos.
       Tania **en-**fattened the chickens
       'Tania fattened the chickens.'

2.2. Gradable base predicates

Before discussing the restrictions on the bases that appear in degree achievements with *en-*, let me first briefly introduce gradable predicates more generally, which are the relevant ones for the discussion to follow in this section (Martínez Vera, 2016).[2] Following extensive literature

[2]From a traditional perspective, bases in degree achievements with *en-* are adjectives and bases in change of location verbs with *en-* are nouns. From a semantic point of view, however, the relevant distinction is between gradable (for degree achievements) and non-gradable (for change of location verbs) bases—see section 3.3 for discussion on the latter. This is the distinction I adopt in this paper. See Martínez Vera (2016) for further discussion, including morphological evidence against the traditional view.

on the topic (Cresswell, 1976; Klein, 1991; Kennedy and McNally, 2005; Pedersen, 2015), gradable base predicates can be characterized in terms of scales, which are sets of linearly ordered degrees d along some dimension associated with a base predicate. A scale associated with a base predicate S_P is defined as follows:

(5) The scale associated with a gradable base predicate S_P is a pairing $\langle S_P, < \rangle$ or $\langle S_P, > \rangle$, where $<$ or $>$ is a linear order on S_P.

The minimal and maximal degrees in the scale associated with a gradable base predicate S_P are defined in (6)—note that if min_{S_P} or max_{S_P} exists, it is unique (since the scale is linearly ordered):

(6) a. min_{S_P}, the minimal degree in the scale associated with the relevant base predicate, is defined as the degree d such that no degree $d' < d$ (for $d, d' \in S_P$).
b. max_{S_P}, the maximal degree in the scale associated with the relevant base predicate, is defined as the degree d such that no degree $d < d'$ (for $d, d' \in S_P$).

I assume that gradable predicates denote relations of type $\langle d, \langle e, it \rangle \rangle$ (throughout this paper, I will use i for the type of eventualities) which are true of degree d, individual x and eventuality e if and only if x has d in the scale associated with the base in e; I assume that d is kept constant throughout e in this case—see Kennedy and McNally (2005), Morzycki (2015), among others.

The scale associated with a predicate could have (i) no minimal or maximal degree, i.e., open scales (7a), (ii) either a minimal or a maximal degree, i.e., partially closed scales (more specifically, bottom- and top-closed scales), as in (7b), or (iii) both a minimal and a maximal degree, i.e., closed scales, as in (7c) (Kennedy and McNally, 2005).[3] (7) illustrates the same dimensions, i.e., beauty in (7a), cleanliness/dirtiness and curliness/straightness (7b), and emptiness/fullness in (7c) but opposite orderings, as indicated in the parentheses next to each item.

(7) a. *Open scales*
ugly (>) beautiful (<)
b. *Partially closed scales*
clean (>) dirty (<)
curly (>) straight (<)
c. *Closed scales*
empty (>) full (<)

Degree achievements with *en-* are derived with gradable bases. In particular, bases that have open scales associated with them are possible in verbs with *en-*, as exemplified in (8):

(8) a. **en-**sanchar 'to widen' *base:* ancho 'wide'
b. **en-**friar 'to cool' *base:* frío 'cool'

[3] Kennedy and McNally (2005) distinguish these different kinds of scales based on the adjunction of adverbial expressions like *completely* or *100%* to the relevant gradable base. When it is possible to adjoin such expressions, the scale associated with the gradable base is closed on the end that is targeted. Take the antonyms *straight* and *curly* as examples, which share the same scale, but point towards different ends. Adjoining *completely* is possible with the former but not with the latter, as shown in (i). This suggests that the scale here is open on the curly end but is closed on the straight end.

(i) The hair is completely ??curly/straight.

Bases that have partially closed scales associated with them are also possible in verbs with *en-*, but only if they are bottom-closed, as exemplified in (9):

(9) a. **en-**suciar 'to dirty' *base:* sucio 'dirty'
b. **en-**crespar 'to curl' *base:* crespo 'curly'

Bases with partially closed scales that are top-closed or closed scales are not possible in verbs with *en-*, i.e., bases with a maximum are not possible in verbs with *en-* (Martínez Vera, 2016). This restriction is exemplified in the ungrammatical forms in (10):[4]

(10) a. *__en-__lisar 'to straighten' *base:* liso 'straight'
(cf. alisar 'to straighten')
b. *__en-__llenar 'to fill' *base:* lleno 'full'
(cf. llenar 'to fill')

3. Change of location verbs with *en-*

This section discusses change of location verbs with the prefix *en-*. I will first introduce the (intuitive) meaning they convey and will then turn to the base predicates that are present in change of location verbs with *en-*, which are non-gradable.

3.1. General meaning

Change of location verbs with *en-* allow two readings, namely, a location reading and a locatum reading (Gumiel et al., 1999; Gibert Sotelo and Pujol Payet, 2015; Martínez Vera, 2016). Informally, the location reading can be stated as 'to put *x* in *y*', for theme *x* and base predicate *y*, and the locatum reading can be stated as 'to put *y* in/on *x*', for theme *x* and base predicate *y* (I formalize these readings in section 5).[5] The examples in (11)-(12) illustrate these readings. (11) exemplifies a verb with a location reading, i.e., the bird (the theme) is put in a cage (the base); (12) exemplifies a verb with a locatum reading, i.e., a saddle (the base) is put on the horse (the theme).

(11) a. **en-**jaular 'to cage'
b. Daniel **en-**jauló el pájaro.
Daniel **en-**caged the bird
'Daniel jailed the bird.'

[4] An account of telicity contrasts in verbs with *en-* lies beyond the scope of this paper. Let me point out, however, what the facts are: expressions with degree achievements with *en-* are very similar to expressions with English degree achievements in which no lexical maximum is present, i.e., when uttered out of the blue, they are compatible with atelic adverbials; telic adverbials are somewhat degraded—see, e.g., Hay et al. (1999), Kennedy and Levin (2008), among others for relevant discussion. (i) illustrates this contrast: while the atelic adverbial *durante dos minutos* 'for two minutes' is good, the telic adverbial *in cinco minutos* 'in five minutes' is (somewhat) degraded:

(i) Meloddye **en-**crespó el cabello durante cinco minutos / ?en cinco minutos.
Meloddye **en-**curled the hair for five minutes in five minutes
'Meloddye curled the hair for/?in five minutes.'

[5] More specifically, depending on the base, some verbs only allow a location reading, some verbs only allow a locatum reading and some verbs allow both readings. In this paper, I make a proposal that makes it possible, in principle, for every verb to be ambiguous (see section 5). Research with regard to the constraints on when each reading is available is left for a future occasion.

(12) a. **en-**sillar 'to saddle'
b. Victoria **en-**silló el caballo.
Victoria **en-**saddled the horse
'Victoria saddled the horse.'

In fact, it is worth pointing out that the same change of location verb may allow both readings (which, in the case under discussion, vary depending on the context of utterance). This is exemplified (13). The location reading is given in (13a): in this case, the turkey (the theme) changes location, as it is put in vinegar (the base). The locatum reading is given in (13b): in this case, the vinegar (the base) is put on the turkey (the theme).[6]

(13) Meloddye **en-**vinagró el pavo.
Meloddye **en-**put.vinegar the turkey
a. 'Meloddye put the turkey in vinegar' (location)
b. 'Meloddye put vinegar on the turkey.' (locatum)

3.2. Some comments about lexical aspect

The two different readings of change of location verbs with *en-* correspond with different lexical aspects.[7] Under the location reading (e.g., (11) or (13a)), expressions with change of location verbs with *en-* are accomplishments (i.e., eventualities where there is a change taking place in some non-instantaneous amount of time such that an endpoint is reached at the end of the change). Under the locatum reading (e.g., (12) or (13b)), expressions with change of location verbs with *en-* are achievements (i.e., eventualities where change is punctual or instantatenous). Although further discussion is needed in this regard, I will briefly illustrate this difference by means of the adjunction of three different adverbial expressions targeting the temporal constitution of the cases under discussion (Rothstein, 2004).

In particular, I will make use of a punctual adverbial, which locates an eventuality at a particular point in time. Adjoining a punctual adverbial is possible only if the relevant eventuality is an achievement. The test in English for this is *at α time*. The Spanish equivalent of this test makes use of the preposition *a* 'at' and the actual expression to be used is *a las 5 pm* 'at five pm'. I will also make use of an adverbial that locates the end of eventualities; specifically, I use the *in α time* test. Adjoining an adverbial of this kind is possible only if the relevant eventuality is an accomplishment. The Spanish equivalent of the test makes use of the preposition *en* 'in' and the actual expression to be used is *en cinco minutos* 'in five minutes' (i.e., there is some time span before the end of the eventuality is located). Finally, I will make use of an expression targeting duration (where no endpoint is reached), specifically, I make use of the *for α time*

[6] In this paper, I mainly focus on concrete locations. However, it is worth pointing out that more abstract/metaphorical change of location verbs are also possible. This is exemplified in (i)—the base predicate in the verb is *dios* 'god':

(i) a. **en-**diosar 'to put in a pedestal'
b. Los profesores **en-**diosaron a Tania.
the teachers **en-**put.in.pedestal Tania
'The teachers put Tania in a pedestal.'

See Spalek (2014) for discussion regarding abstract/metaphorical uses of cases somewhat similar to (i) in Spanish.

[7] The literature on lexical aspect is too extensive to make justice to it in this paper. See Rothstein (2004) for an overview.

test. Adjoining an adverbial targeting duration is possible only if the relevant eventuality is an activity; for the cases under discussion, this test is relevant because it targets that a result state is extended in time, which is possible with achievements (but not with accomplishments, where the duration of the whole eventuality is targeted by this kind of adverbial). The Spanish equivalent of this test makes use of the preposition *durante* 'for' and the actual expression to be used is *durante cinco minutos* 'for five minutes'.

I add these adverbials to sentences (11)-(12)—they are to be understood as uttered out of the blue. (14) illustrates the location reading with a sentence with the verb ***en-****jaular* 'to cage'. The contrast between the felicity of the punctual adverbial and the infelicity of the adverbial locating the end of an eventuality shows that the change is instantaneous (i.e., (14) illustrates an achievement): while it is possible for the change to take place in an instant (i.e., *a las 5 pm* 'at 5 pm'), adjoining an adverbial that targets a time span reaching an endpoint (i.e., *en cinco minutos* 'in five minutes') is not. The use of the adverbial targeting duration (i.e., *durante cinco minutos* 'for five minutes') is possible, but the reading it gets is that the state of being caged lasts five minutes—i.e., the change is punctual; it has no duration. This reading is expected if the change taking place is instantaneous.

(14) Daniel **en-**jauló al pájaro a las 5 pm / ??en cinco minutos / durante cinco minutos.
Daniel **en-**caged the bird at the 5 pm / in five minutes / for five minutes
'Daniel jailed the bird at 5 pm/??in five minutos/for five minutes.'

The case in (15) is different—aspectually, here we are dealing with an accomplishment. (15) illustrates the locatum reading with a sentence with the verb ***en-****sillar* 'to saddle'. In this case, the preferred adverbial is the one indicating that there is a time span in which an endpoint is reached (i.e., *en cinco minutos* 'in five minutes') The other two adverbials are less felicitous: the punctual adverbial (i.e., *a las 5 pm* 'at 5 pm') requires that the sentence be accommodated such that change takes place very quickly (which is unlikely given that saddling a horse is not an instantaneous change under normal circumstances); the adverbial targeting duration without reaching an endpoint is infelicitous, as the default reading of (15) is that saddling a horse is a change that ends with the horse being saddled. This discussion thus suggests that, aspectually, (15) illustrates an accomplishment.[8]

(15) Victoria **en-**silló el caballo ?en un segundo / en cinco minutos / ??durante cinco
Victoria **en-**saddled the horse in a second / in five minutes / for five
minutos.
minutes
'Victoria saddled the horse ?in a second/in five minutos/??for five minutes.'

Of relevance for the current discussion is that the account of change of location verbs with *en-* that will be proposed in section 5 will make explicit this aspectual distinction, which arises when comparing location and locatum readings.

[8]As the reader may have already noticed, the examples in (14)-(16) are relevant also with regard to telicity—as anticipated in footnote 4, two of the adverbials like the ones in (14)-(16), which are basically *in-/for-*adverbail expressions, are those used to test telicity contrasts. The discussion in the main text suggests that telic adverbials are the ones compatible with sentences with change of location verbs with *en-* by default. I leave aside an explicit account of this in this paper.

3.3. Non-gradable base predicates

The bases that appear in change of location verbs with *en-* are non-gradable (Martínez Vera, 2016). Here I assume that non-gradable bases denote relations of type $\langle e, it \rangle$ which are true of individual x and eventuality e if and only if x is a member of the extension of the base in e (Heim and Kratzer, 1998).

Below I provide some examples of change of location verbs with *en-* in which it is made explicit what the non-gradable base predicates are.

(16)	a.	**en-**carcelar ‘to cage’	*base:* cárcel ‘jail’
	b.	**en-**jaular ‘to cage’	*base:* jaula ‘cage’
	c.	**em-**botellar ‘to bottle’	*base:* botella ‘bottle’
	d.	**en-**sillar ‘to saddle’	*base:* silla ‘saddle’
	e.	**en-**vinagrar ‘to put vinegar’	*base:* vinagre ‘vinegar’

4. Parallels between the prefix *en-* and the preposition *en*

An extensive literature on Spanish verbs with *en-* points out that the prefix *en-* is similar to the locative preposition *en*, which can be roughly translated to English as ‘in/inside’ or ‘on’—see, e.g., Mateu (2002, 2012) and Fábregas (2010, 2015) for relevant discussion. I will assume this position in this paper and capitalize on it for my proposal; in particular, I will propose that the prefix *en-* has a preposition-like meaning. In this section, I will make explicit in what sense expressions with the prefix *en-* and with the preposition *en* are parallel.[9]

Romeu (2013, 2014) shows that the preposition *en* has a flexible locative meaning which corresponds with the English locative prepositions *in/inside* or *on*. These uses are exemplified in (17)-(18)—for clarity, I underline the English equivalent of the preposition in the translation. Thus, (17) conveys the meaning that the thief is in jail and (18) conveys the meaning that a saddle is put on the horse.

(17) El ladrón está **en** la cárcel.
the thief is **en** the jail
‘The thief is in jail.’

(18) El jinete puso la silla de montar **en** el caballo.
the horseman put the saddle of mount **en** the horse
‘The horseman put the saddle on the horse.’

Interestingly, change of location verbs with *en-*, discussed in section 3, display the same flexibility in that they can convey both location and locatum readings. In particular, one can construct examples that are very similar to (17)-(18) with change of location verbs with *en-*. Thus, (19), with the prefix, is very similar to (17), with the preposition, in that the thief is (put) in jail in both cases; (20), with the prefix, is very similar to (18), with the preposition, in that a saddle is put on the horse in both cases.

(19) El policía **en-**carceló al ladrón.
the policeman **en-**jailed the thief

[9] It should be noted that not all uses of the preposition *en* are attested in the verbs with the prefix *en-*. See Romeu (2013, 2014) for discussion.

'The policeman jailed the thief.'

(20) El jinete **en-**silló el caballo.
the horseman **en-**saddled the horse
'The horseman saddled the horse.'

Although the previous parallels hold very well when change of location verbs are considered, a question remains with regard to degree achievements (see section 2): in what sense do the parallels discussed in this section hold in this case (if they hold at all)? In section 5, I argue that there is in fact a link between the preposition *en* and the prefix *en-* when degree achievements are considered. In particular, I will link the locative meaning of the prefix *en-* as discussed in this and the previous sections with the ban on top-closed and closed scales in gradable base predicates in degree achievements with *en-*. I will tie this restriction to the fact that the locative preposition *en* cannot indicate a goal or a terminal point—see Romeu (2013, 2014) for discussion regarding the preposition *en* and its inability to convey a goal or terminal point. This is shown in (21): in the presence of *en*, the sentence cannot mean that the girl went to Lima—in this case, the appropriate means to convey the intended meaning of (21) is the preposition *a*.

(21) *La chica fue **en** Lima.
the girl went **en** Lima
Intended: 'The girl went to Lima.'

I will propose that the impossibility of indicating a goal or a terminal point is translated into the verbal domain—degree achievements specifically—as a ban on the presence of an absolute endpoint (a lexical maximum) in the scale associated with the gradable base under consideration (i.e., why verbs such as ******en-lisar* 'to straighten' are ungrammatical, but verbs such as ***en-****crespar* 'to curl' are good).

5. Proposal

This section provides a compositional account of degree achievements and change of location verbs with *en-*. Section 5.1 summarizes the discussion up to this point, emphasizing the issues that I will account for. Section 5.2 makes explicit what my assumptions are with regard to the spatial domain, an issue that has not been explicitly addressed. Section 5.3 discusses my core proposal making explicit what the parallels between degree achievements and change of location verbs with *en-* are, which suggests that the unified account is, in principle, possible. Section 5.4 addresses the issue with regard to the fact that degree achievements with *en-* are only derived from bases whose scale does not have a lexical maximum.

5.1. Interim summary

The discussion up to this point can be summarized as follows:

(22) Degree achievements with *en-*
a. They convey the meaning that the theme increases in degree along the scale associated with the gradable base in the relevant verb.
b. Bases in these verbs are gradable; more specifically, the scale associated with the base can be open or partially closed; if the latter is the case, it has to be top-open (i.e., scales with a lexical maximum do not derive degree achievements with *en-*).

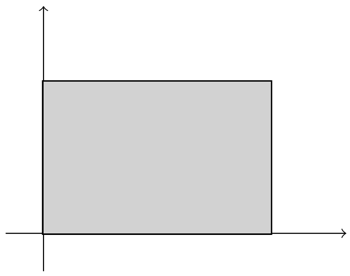

Figure 1: Region of *this piece of paper*

(23) Change of location verbs with *en-*
  a. They can yield location (informally, 'to put x in y' for theme x and base predicate y) and locatum (informally, 'to put y in/on x' for theme x and base predicate y) readings.
  b. From a lexical aspect point of view, expressions with these verbs are accomplishments (which corresponds with locatum readings) or achievements (which corresponds with location readings).

(24) The prefix *en-* incorporates the core locative meaning of the preposition *en* (which roughly corresponds with the English prepositions *in/inside* and *on*).

(24) is the crucial issue that I will build upon to suggest that degree achievements and change of location verbs with *en-* should be analyzed along similar lines.

5.2. Assumptions in the spatial domain

In addition to the assumptions I made with regard to the degree domain, which were discussed in section 2.2, with regard to the spatial domain, I assume a two-dimensional Euclidean space V over the positive real numbers whose center is 0 (Zwarts and Winter, 2000)—I assume a two-dimensional space instead of a three-dimensional one for simplicity. I assume that each coordinate is a point and use p for the type of points. I further assume a region function R that takes individual x and eventuality e as input and gives as output the set of points x occupies in space (Wunderlich, 1991) in e (Nam, 1995)—I assume, for simplicity, that the region of x is kept constant throughout the run time of e. $R(x,e)$ has a boundary and an interior. The boundary of $R(x,e)$ equals the intersection of the closure of $R(x,e)$ with the closure of its complement. The interior of $R(x,e)$ equals the closure of $R(x,e)$ without its boundary (Nam, 1995). For instance, the region of *this piece of paper* in an eventuality could be represented as in Figure 1. The bold line corresponds with the boundary and the grey area, with the interior. Since I am limiting myself to a two-dimensional space, the region equals the area of the entity.

5.3. Compositional account

In what follows, I will assume the L(ogical) F(orm)s in (25). (25a) is the LF I assume for degree achievements with *en-*; (25b) is the LF I assume for change of location verbs with *en-* (the proposal is restricted to the VP level).

(25) a. [[[en-$_{\text{DA}}$ INCREASE] gradable base] theme]

b. [[[en-$_{\text{CL}}$ PATH] non-gradable base] theme]

Some comments are in order with regard to (25). I assume that *en-* is a locative element (see (24))—in what sense *en-* is a 'locative element' in the case of degree achievements will become apparent below. I will distinguish two *en*-s, namely, *en*-$_{\text{DA}}$ for the *en-* that appears in degree achievements and *en*-$_{\text{CL}}$ for the *en-* that appears in change of location verbs. The two will be discussed in tandem, so the parallels between the two become apparent. I further assume that there are two (abstract) lexical items that combine with *en*-$_{\text{DA}}$ and *en*-$_{\text{CL}}$ to derive a degree achievement and a change of location verb respectively. These are INCREASE for degree achievements (Hay et al., 1999; Kennedy and Levin, 2008; Pedersen, 2015) and PATH for change of location verbs (Zwarts and Winter, 2000; Gehrke, 2008; Svenonius, 2010)—these are intended to capture (22a)-(23a) respectively, as will be made explicit below. The intuition that the split between the prefix and INCREASE/PATH captures is that the latter derives a path from the former, which is common in the treatment of locative and directional prepositions (Zwarts and Winter, 2000).

As anticipated in (24), the crucial issue for my account is to make explicit in what sense the core locative meaning of the preposition *en* applies when the prefix of the same phonological shape is considered. In particular, to characterize *en*-$_{\text{DA}}$ and *en*-$_{\text{CL}}$, I will combine the approaches to gradable bases, as in Kennedy and McNally (2005)—see also Kennedy (2007), Piñón (2008), Spalek (2014) and Pedersen (2015)—and to prepositions, as in Zwarts and Winter (2000)—see also Zwarts and Winter (2000), Gehrke (2008) and Svenonius (2010). Intuitively, there is a core prepositional meaning that would be applying in the case of degree achievements and in the case of change of location verbs. I assume as baseline that the core prepositional meaning of the prefix is the denotation that the literature gives for the locative English preposition *in/inside*, namely, that this preposition denotes a ternary relation between individuals x, y and eventuality e such that the region of x is a subset of the region of y in e—see Zwarts and Winter (2000) for relevant discussion.

Making things more precise, with regard to *en*-$_{\text{DA}}$, I propose that the prefix takes gradable base P, degree d, individual x and eventuality e as arguments and denotes a relation, which I label in_{DA}, that holds if and only if x has degree d in the scale associated with P in e. The intuitive prepositional meaning of *en*-$_{\text{DA}}$ here is that there is an individual that has a degree in the scale of the base (in an eventuality). With regard to *en*-$_{\text{CL}}$, I propose that the prefix takes non-gradable base P, set of points X, individual x and eventuality e as arguments and denotes a relation in_{CL} that holds if and only if the region of x is a subset of X, which is in the region of P,[10] in e. As can be readily noted, this denotation is very similar to the denotation of *in/inside* discussed above in that the subset relation between the regions of two individuals is crucial. The denotations of *en*-$_{\text{DA}}$ and *en*-$_{\text{CL}}$ are thus constructed in a parallel way, the differences being the type of the base ($\langle d, \langle e, it \rangle \rangle$ for the former and $\langle e, it \rangle$ for the latter), and whether there is a degree argument (for the former) or a set of points argument (for the latter).[11] These differences, I suggest, are the ones present due to the differences in domains, which basically are reduced to the presence of degrees vs. regions and points in space.

[10] I come back to what the region of non-gradable base P is below.

[11] With regard to this second issue, the parallels could be made even stricter if, instead of degrees, sets of degrees are used (Schwarzschild and Wilkinson, 2002). I stick to the simpler version following the literature on gradable bases and degree achievements

An issue that needs to be addressed, in particular, regarding change of location verbs, concerns the following: what is the region of a non-gradable base? This question arises, since in the literature about prepositions (Nam, 1995; Zwarts and Winter, 2000; Gehrke, 2008; Svenonius, 2010), prepositions denote relations between the regions of entities (not of base predicates)—recall that the denotation of the preposition *in* above is stated as a relation between the region of an entity being a subset of the region of another entity in an eventuality. The only approach I know of that provides an explicit account of what it means for a predicate to have a region is Mador-Haim and Winter (2015), who address the semantics of locative indefinites.[12] The proposal in this section loosely follows their approach in that the region of a base predicate is to be understood in terms of the region of the entities in its extension. The venue I take is to analyze the region of a non-gradable base in terms of the region of a token of such base. In particular, I propose a choice function f that picks out a token of the non-gradable base. Within the account pursued in this section, my proposal is that f applies to (the denotation of) a non-gradable base and gives as output one element in its extension. For example, take non-gradable *jail*, which denotes a relation that holds of individuals that are jails in an eventuality. f picks out one such individual (then, this individual will be mapped to its region). I assume that this choice function will be used as a last resort mechanism, which in this case means that it will appear whenever the region of the a non-gradable base needs to be computed—this is the case in change of location verbs with *en-*. Note that the choice function under discussion does not apply in the case of degree achievements with *en-*, as no regions (in space) are involved.

The denotations of *en-*$_{\text{DA}}$ and *en-*$_{\text{CL}}$ appear below in (26)-(27) respectively. Consider (26) first, the case of *en-*$_{\text{DA}}$. $[\![\text{en-}_{\text{DA}}]\!]$ takes gradable base P, degree d, individual x and eventuality e as arguments and is true if and only if relation in_{DA} holds, which is the case if and only if x has d in the scale of P in e. Consider now (27), the case of *en-*$_{\text{CL}}$. $[\![\text{en-}_{\text{CL}}]\!]$ takes non-gradable base P, set of points X, individual x and eventuality e as arguments and is true if and only if relation in_{CL} holds, which is the case if and only if x's region is a subset of X, where X is the (relevant) region of a token of P (as picked out by choice function f) in e. Thus, (26)-(27) are parallel: they share a core denotation where the main difference lies in whether it is applied in the degree or in the spatial domain.

(26) a. $[\![\text{en-}_{\text{DA}}]\!] = \lambda P_{\langle d,\langle e,it\rangle\rangle}\lambda d\lambda x\lambda e[in_{DA}(x,d,P,e)]$
b. For any predicate $P_{\langle d,\langle e,it\rangle\rangle}$, degree d, theme x, and eventuality e, $in_{DA}(x,d,P,e)$ holds iff $P(x,d,e)$ holds, i.e., iff x has $d \in S_P$ in e.

(27) a. $[\![\text{en-}_{\text{CL}}]\!] = \lambda P_{\langle e,it\rangle}\lambda X\lambda x\lambda e[in_{CL}(x,X,P,e)]$
b. For any predicate $P_{\langle e,it\rangle}$, set of points X, theme x, and eventuality e, $in_{CL}(x,X,P,e)$ holds iff x's region is a subset of X in e, where X is a subset of the region of a P-token as picked out by choice function f.

What is now missing is the denotation of INCREASE and PATH (see (25a)-(25b)). Their role is to derive a 'path' from a 'locative' expression. In the case of degree achievements, it will derive a predicate in which there is a change (an increase) in degrees in an eventuality (Hay et al., 1999; Kennedy and Levin, 2008; Pedersen, 2015)—this is (22a) in the summary in section 5.1. In

[12]More generally, this issue falls under the discussion of what the denotation of a kind or property is, which can be traced back to Carlson (1977) and, more recently, to Chierchia (1998). What is relevant for my purposes is how to treat predicates in locative expressions, which is part of the task Mador-Haim and Winter (2015) undertake.

the case of change of location verbs, it will derive a path, i.e., an individual will change from one location to some other location (Zwarts and Winter, 2000; Beavers, 2011)—this is (23a) in the summary in section 5.1. The denotations of INCREASE and PATH are shown below—G is a variable of the type of en_{DA} and F is a variable of the type of en_{CL}.

(28) $[\![\text{INCREASE}]\!] = \lambda G \lambda P_{\langle d,\langle e,it\rangle\rangle} \lambda x \lambda e \exists d,d'[G(P,d,x,ini(e)) \wedge G(P,d',x,fin(e)) \wedge d < d']$

(29) $[\![\text{PATH}]\!] = \lambda F \lambda P_{\langle e,it\rangle} \lambda x \lambda e \exists X[\neg F(P,X,x,ini(e)) \wedge F(P,X,x,fin(e))]$

I will now exemplify the proposal. Consider the example in (30a) (which repeats (3b)), with a degree achievement. Its LF and denotation appear below.

(30) a. Meloddye **en-**crespó el cabello.
Meloddye **en-**curled the hair
'Meloddye curled the hair.'
b. [[[en-$_{\text{DA}}$ INCREASE] curly] the hair]
c. $[\![(30\text{b})]\!] = \lambda e \exists d,d'[in_{DA}(h,d,curly,ini(e)) \wedge in_{DA}((h,d',curly,fin(e)) \wedge d < d']$
d. In words, (30b) is true of eventuality e if and only if the hair increases in curliness in e.

Consider now example (31a) (which repeats (2)), with a change of location verb. Its LF and denotation appear below. Note that (31) presents an example of the location reading only (in this example, this is the reading in which the theme is put in jail)—see (23b) in the summary in section 5.1. In terms of lexical aspect, the example below instantiates the achievement case, in which there is a change that takes place in a very short period of time.

(31) a. Daniel **en-**carceló a Gianfranco.
Daniel **en-**jailed Gianfranco
'Daniel jailed Gianfranco.'
b. [[[en-$_{\text{CL}}$ PATH] jail] Gianfranco]
c. $[\![(31\text{b})]\!] = \lambda e \exists X[\neg in_{CL}(g,X,jail,ini(e)) \wedge in_{CL}(g,X,jail,fin(e))]$
d. In words, (31b) is true of eventuality e if and only if Gianfranco changes from not being in a jail to being in it in e.

The question remains as to how to account for locatum readings—see (23b) in the summary in section 5.1. Here I sketch an approach that exploits how parts of the theme are mapped into parts of the event (Krifka, 1998; Beavers, 2011, 2012). The proposal to follow is rather tentative, but illustrates how this can be done (restricting to the cases at hand). Further research into this topic, I believe, will show how the cases under discussion could be made compatible with more general theories like the ones in the references above.

To account for the locatum readings, I propose to derive PATH$'$ from PATH in (38). The denotation of PATH$'$ appears in (32). It conveys the meaning that the theme starts out somewhere that is not in the region of the relevant token of the base. It then changes in that its parts transition to being in the relevant region of the token of the base in possibly different parts of the event. I make the simplifying assumptions that all (contextually relevant) parts of the theme end up in such region and that events are formed by subevents which represent (temporal) stages such that a (temporal) precedence relation can be established among them—I represent the precedence relation as $\prec$ and the part-whole relation as $\sqsubseteq$ (Krifka 1998).[13]

(32) $[\![\text{PATH}']\!] = \lambda F \lambda P_{\langle e,it\rangle} \lambda x \lambda e \forall y[y \sqsubseteq x \rightarrow \exists e'[e' \sqsubseteq e \wedge ini(e) \prec e'$
$\wedge \exists X[\neg F(x,X,P,ini(e)) \wedge F(y,X,P,e')]]]$

As example, consider the case in (33) (which repeats (13)), which includes the verb ***en-****vinagrar* 'to put vinegar'. Here I illustrate the locatum reading.[14] In this case, there is an accomplishment-like change in that vinegar is poured on (different parts of) the turkey—under my account, this reading is reached by saying that all parts of the turkey are put in vinegar in different parts of the relevant eventuality. This proposal thus makes explicit why locatum readings and accomplishments go together in the cases under discussion.

(33) a. Meloddye **en-**vinagró el pavo.
Meloddye **en-**put.vinegar the turkey
'Meloddye put vinegar on the turkey.'

b. [[[en-$_{\text{CL}}$ PATH$'$] vinegar] the turkey]

c. $[\![(33b)]\!] = \lambda e \forall y[y \sqsubseteq t \rightarrow \exists e'[e' \sqsubseteq e \wedge ini(e) \prec e'$
$\wedge \exists X[\neg in_{CL}(t,X,vinegar,ini(e)) \wedge in_{CL}(y,X,vinegar,e')]]]$

d. In words, (33b) is true of eventuality *e* iff the turkey starts out as not being in vinegary substance at the beginning of *e*; then all parts *y* of the turkey end up being in vinegary substance in parts e' of *e*.

5.4. The ban on lexical maximal degrees in degree achievements

The proposal in the previous section with regard to degree achievements has accounted for (22a) in the summary in section 5.1, but has not accounted for why verbs with *en-* do not allow bases with lexical maxima—i.e., (22b) in the summary in section 5.1. This is the issue that will be discussed in this section. The claim made here is that this ban follows from the core prepositional meaning of the prefix. I state this in terms of non-triviality, specifically, that the interior of the base is non-trivial—see Gajewski (2002) for discussion of (non-)triviality in natural language. The proposal made here for degree achievements with *en-* is that it should be possible to make use of the interior of the scale. Here I assume that a scale has a boundary and an interior (just as in the spatial domain; see section 5.2). The boundary of a scale corresponds with lexical maximal degrees; the interior of a scale corresponds with all non-maximal degrees. Relevant in this discussion is the consideration of the principle of Interpretive Economy (Kennedy, 2007; Kennedy and Levin, 2008), which states that lexical means are maximized. In the case under discussion, this means that, whenever the scale associated with a base has a lexical maximum, it would be preferred over any other degree, thus cancelling out the interior of the base. I take non-triviality in degree achievements with *en-* to mean that maximal degrees are excluded; otherwise, interior degrees would be treated as if they are not there (by default)—i.e., they will

[13] In my proposal for change of location verbs with *en-*, the locatum readings are derived, in the sense that the item that is tied to them, namely, PATH$'$, is derived from another one, namely PATH, which is involved in the location readings. As pointed out to me by Jaume Mateu, this is perhaps a welcome result. For instance, in French, the change of location verbs derived with *en-*, e.g., ***em-prisonner*** 'to jail', only yield location readings (locatum verbs undergo a different process). Although tentative, this would suggest that location readings are in fact basic, the Spanish cases displaying a further diachronic step in that locatum readings have also become available (in some cases at least).

[14] The location reading is parallel to the example in (31) above.

not be used if the relevant scale has a maximal degree. More formally, following a common use in the representation of combinatorial restrictions in the account of word-formation—see Pustejovsky (1995), Asher (2011) and Spalek (2014) for relevant discussion—, I capture non-triviality as a domain (combinatorial) restriction in the denotation of *en*-$_{\text{DA}}$ stating that if the relation denoted by *en*-$_{\text{DA}}$ holds, then the relevant scale does not have a lexical maximal degree, i.e., interior degrees can in fact be used. Under this approach, top-closed and closed scales cannot appear in degree achievements with *en*-, because their lexical means (i.e., the maximum) cannot be used. I thus revise the denotation of *en*-$_{\text{DA}}$ in (26a) in (34), so that the domain condition is added.

(34) $[\![\text{en-}_{\text{DA}}]\!] = \lambda P_{\langle d,\langle e,it\rangle\rangle} : \forall x,d,e[in_{DA}(x,d,P,e) \rightarrow d \neq max_{S_P}].\lambda d\lambda x\lambda e[in_{DA}(x,d,P,e)]$

Since this restriction is added in (34), the denotation of INCREASE in (28) needs to change accordingly, making it defined when the argument of the type of the prefix (variable G below) is defined. This revision is undertaken in (35).

(35) $[\![\text{INCREASE}]\!] = \lambda G\lambda P_{\langle d,\langle e,it\rangle\rangle} : P \in dom(G).\lambda x\lambda e\exists d,d'[G(P,d,x,ini(e))$
$\wedge G(P,d',x,fin(e)) \wedge d < d']$

Recall the account of example (30a), which is repeated below. In (36), I incorporate the changes made in (34)-(35). Now it is explicitly stated that the scale associated with the base lacks a lexical maximun.

(36) a. Meloddye **en-**crespó el cabello.
Meloddye **en-**curled the hair
'Meloddye curled the hair.'
b. [[[en-$_{\text{DA}}$ INCREASE] curly] the hair]
c. $[\![(36b)]\!]$ is defined if and only if $\forall x,d,e[in_{DA}(x,d,curly,e) \rightarrow d \neq max_{S_{curly}}]$
When defined, $[\![(30b)]\!] = \lambda e\exists d,d'[in_{DA}(h,d,curly,ini(e))$
$\wedge in_{DA}(h,d',curly,fin(e)) \wedge d < d']$
d. In words, (36b) is defined if and only if the scale associated with curly does not have a maximum. When defined, (36b) is true of eventuality *e* if and only if the hair increases in curliness in *e*.

Having stated how to account for the combinatorial restrictions in the degree achievement case, the question now is: how does this apply in the case of change of location verbs? I take that the domain restriction stated above applies capturing the intuitive idea that the interior of the region of the (non-gradable) base is not empty (this is the sense of non-triviality in this case). More formally, I propose a domain (combinatorial) restriction in the denotation of *en*-$_{\text{CL}}$ stating that if the relation denoted by *en*-$_{\text{CL}}$ holds, then the interior of the set of points argument (which is in the region of a token of the base as picked out by choice function f) is not empty. This application in the spatial domain is similar in spirit to an observation made by Zwarts and Winter (2000): they point out that, in expressions such as *the food in the bowl*, the interior of the region of the bowl is technically empty; however, in these expressions it is understood as non-empty in the sense that such region is taken to be convex, i.e., the region of the bowl includes its walls (i.e., the boundary) and the space within those walls (i.e., the interior). I thus revise the denotation in *en*-$_{\text{CL}}$ to incorporate this domain restriction. This is done in (37).

(37) $[\![\text{en-}_{\text{CL}}]\!] = \lambda P_{\langle e,it\rangle} : \forall x,X,e[in_{CL}(x,X,P,e) \rightarrow int(X) \neq \emptyset].\lambda X\lambda x\lambda e[in_{CL}(x,X,P,e)]$

As done with regard to INCREASE, PATH and PATH$'$ also have to change accordingly. They are defined when the argument of the type of the prefix (variable F below) is defined. These revisions are undertaken in (38)-(39) respectively.

(38) $[\![\text{PATH}]\!] = \lambda F \lambda P_{\langle e,it\rangle} : P \in dom(F).\lambda x \lambda e \exists X[\neg F(P,X,x,ini(e)) \wedge F(P,X,x,fin(e))]$

(39) $[\![\text{PATH}']\!] = \lambda F \lambda P_{\langle e,it\rangle} : P \in dom(F).\lambda x \lambda e \forall y[y \sqsubseteq x \rightarrow$
$\exists e'[e' \sqsubseteq e \wedge ini(e) \prec e' \wedge \exists X[\neg F(x,X,P,ini(e)) \wedge F(y,X,P,e')]]]$

I leave it to the reader to check how the domain restriction in (37) applies in the case of examples (31a) (which illustrates the location reading) and (33a) (which illustrates the locatum reading) in section 5.3, which basically says that if the relation denoted by *en*-$_{\text{CL}}$ holds of its arguments, the interior of a token of the base (of which the set of points argument is a subset) is not empty.

6. Conclusion

The main contribution of this paper has been to make explicit what the parallels between degree achievements and change of location verbs are to shorten the gap between these two domains. Focusing on one particular case, namely, verbs with the prefix *en-* in Spanish, which empirically motivates the task undertaken in this paper, I have provided an account that has made explicit how the the core meaning of the prefix under discussion is involved in deriving both degree achievements and change of location verbs.

Although the focus in this paper has been on Spanish, the discussion is of relevance cross-linguistically, the present work constituting the first explicit semantic account in this realm. Here I briefly mention some remaining issues within Romance for illustration. The patterns discussed in this paper are actually similar to what happens in other Romance languages, such as French or Italian. These languages also have elements like *en-* in Spanish that appear in the derivation of degree achievements and change of location verbs. This is exemplified in (40). This suggests that the account developed in this paper may be extensible to other Romance languages (at least).

(40) a. *Degree achievements*
Fr. **en-**durcir / It. **in-**durire 'to harden' *bases:* Fr. dur / It. duro 'hard'
b. *Change of location verbs*
Fr. **em-**prisonner / It. **in-**carcerare 'to jail' *bases:*Fr. prison / It. carcere 'jail'

Variation within Romance can be further explored. For instance, while French, Italian and Spanish display the restriction with regard to not allowing top-closed and closed scales (Di Sciullo, 1997; Martínez Vera, 2016), Catalan does not have it. For example, in Catalan, ***em-**plenar* 'to fill', with base *ple* 'full', which has a closed scale associated with it, is possible.

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On the source of proper partitivity[1]

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Abstract. This paper investigates into the meaning and use of partitive constructions such as *three of John's lawyers*. These constructions have long been observed to give rise to inferences of proper partitivity: upon hearing a sentence like *Sue talked to three of John's lawyers*, we spontaneously understand that John has more than three lawyers, that is we interpret the partitive *three of John's lawyers* as denoting a proper subset of the denotation of *John's lawyers*. Contra the common idea that proper partitivity follows from the plain meaning of partitives, I defend here the view that partitives semantically express partitivity *tout court*, that is they encode the reflexive 'part-of' relation, and that proper partitivity comes about as a result of a presuppositional implicature on the basis of the competition between those indefinite expressions and their non-partitive definite alternatives, e.g., *John's three lawyers*.

Keywords: partitives, proper partitivity, anti-definiteness, anti-maximality, *Maximize Presupposition!*, exhaustivity operator, scalar implicatures, oddness.

1. Introduction

The study of logical expressions (e.g., truth-functional connectives, quantifiers) raises many interesting challenges for formal approaches to natural languages. One of these challenges is to succeed in disentangling their plain from their possibly enriched meaning, that is in disentangling the logical inferences these expressions license simply by virtue of their literal meaning from other kinds of inferences they may give rise to by virtue of other principles or mechanisms being operative in natural languages at the semantics-pragmatics interface (e.g., *or* understood as *not and*, *some* understood as *not all*, the anti-uniqueness inference associated with singular indefinites). The difficulty in taking up on this challenge often boils down to finding suitable empirical tests for singling out the different inferential components at stake and determining their licensing conditions, for instance by varying the properties of the context in which these expression are used (e.g., the speaker's epistemic status) or the logical properties of the grammatical environments in which they occur (e.g., the monotonicity of the environment).

In this paper, I pursue this line of research by investigating into the meaning and use of partitive constructions like *three of the lawyers*, and more specifically into the nature of the part-whole relation expressed by partitive *of* in these constructions, henceforth of_{PART}.[2] As a starting point, let me begin here with two platitudes. First, there exists a variety of partitive constructions, which we can appreciate by emphasizing certain characteristic properties of the different nominals that of_{PART} can possibly relate, as exemplified in (1).

[1]This paper summarizes some of the ideas and material originally presented in Chapter 4 of my doctoral dissertation, Marty (2017), *Implicatures in the DP domain*. I am indebted to Irene Heim, Danny Fox and David Pesetsky for sharing with me their invaluable insights on this topic. For useful discussion and feedback, I am also thankful to my colleagues of the Semantics and Pragmatics group (FB IV) at ZAS, Alan Bale, Brian Buccola, Nick Longenbaugh, Sophie Moracchini, Marcin Wągiel, the reviewers and audiences at SuB 23 and to the proceedings editors. This work was supported by Bundesministerium für Bildung und Forschung (Grant Nr. 01UG1411).

[2]Throughout this paper, I will follow the previous literature and assume that the part-whole relation comes from the semantics of the preposition *of*. The notation of_{PART} is intended to facilitate the distinction between partitive *of* and its possessive homonym, e.g. *a brother of John*, which I will note of_{POSS}.

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(1) a. two of my books — cardinal-count
b. a quarter of my books — fraction-count
c. a quarter of my spare time — fraction-mass
d. two hours of my spare time — measure-mass

Second, despite their diversity, all partitive constructions have something in common: their interpretation exhibits a 'part-of' requirement, hence their name. In short, partitive constructions are sensical only if it is possible to build up the denotation of the higher nominal as a 'part' of the denotation of the lower one, as evidenced by the following contrasts:

(2) a. #I met four of John's three lawyers.
b. I met two of John's three lawyers.

(3) a. #I spent four hours of my three-hour of spare time sleeping.
b. I spent two hours of my three-hour of spare time sleeping.

The research question I will seek to address is the following: what kind of part-whole relation is exactly expressed by partitive constructions? To address this question, I will compare and test two distinct hypotheses about the meaning of *of*$_{\text{PART}}$ that are commonly found in the literature: does *of*$_{\text{PART}}$ encode the 'part-of' relation, (4a), or the stronger 'proper-part' relation, (4b)?

(4) **Two working hypotheses**
a. PARTITIVITY: *of*$_{\text{PART}}$ expresses the 'part-of' relation
$[\![\text{of}_{\text{PART}_{\leq}}]\!](y)(x) = 1$ if and only if $x \leq y$
Example: $a \oplus b \oplus c$ counts 7 parts, namely $a, b, c, a \oplus b, a \oplus c, b \oplus c$ and $a \oplus b \oplus c$.
b. PROPER PARTITIVITY: *of*$_{\text{PART}}$ expresses the 'proper-part' relation
$[\![\text{of}_{\text{PART}_{<}}]\!](y)(x) = 1$ if and only if $x < y$
Example: $a \oplus b \oplus c$ counts 6 proper parts, namely $a, b, c, a \oplus b, a \oplus c$ and $b \oplus c$.

Everything else being equal, the PARTITIVITY hypothesis (a.o., Ladusaw, 1982), (4a), offers the most conservative way to capture the 'part-of' requirement on partitives, e.g., it accounts for the impossibility that an individual made up of n parts be part of another individual made up of less than n parts. However, since its inception in Barker (1998), the PROPER PARTITIVITY hypothesis, (4b), has been largely followed, and with some good reasons. In essence, partitives appear to be subject not just to a 'part-of', but to a 'proper-part' requirement: they give rise to proper partitivity inferences which contribute to their felicity conditions, as exemplified in (5). These data are left unexplained if one assumes that *of*$_{\text{PART}}$ expresses partitivity *tout court*, (4a): unlike the proper-part relation, the part-of relation is reflexive (i.e., everything is part of itself) and so cases of identity qualify by definition as cases of partitivity. On the other hand, these data are accounted for if one assumes that *of*$_{\text{PART}}$ expresses proper partitivity, (4b).

(5) *Proper Partitivity Effects*
a. Sue talked to two of John's lawyers. $\rightsquigarrow$ *John's lawyers are more than two*
b. #Sue talked to two of John's parents. $\rightsquigarrow$ *#John's parents are more than two*

While the PROPER PARTITIVITY hypothesis offers itself as an obvious direction, we shall see in the following that this direction is also misleading: this hypothesis makes incorrect predictions regarding both the distribution and the semantic strength of the proper-part inferences associated with the use of partitives. As a way out of this dilemma, I will propose that, contra appearances, the PARTITIVITY hypothesis is in fact empirically adequate, that is *of*$_{\text{PART}}$ expresses partitivity *tout court*, and that the source of proper partitivity is to be found somewhere else. Specifically, I will argue that proper partitivity comes about as a by-product of the competition between indefinite partitives, *three of the lawyers*, and their presuppositionally stronger, non-partitive definite alternatives, *the three lawyers*: because partitives are semantically weak, they prompt scalar reasoning, the outcome of which results in the proper-part inferences observed in (5). These inferences will be shown to be derivable from general mechanisms of meaning strengthening and ultimately to reduce to genuine anti-maximality implicatures similar to those previously observed in the literature.

The rest of this paper is organized as follows. In Section 2, I present in more detail the PROPER PARTITIVITY view on partitives and summarize its immediate empirical advantages. In Section 3, I present various empirical arguments against this view, establishing by means of different tests that proper partitivity inferences have the linguistic signature of implicated presuppositions. In Section 4, I develop my alternative account on which proper partitivity falls out from the PARTITIVITY hypothesis together with general mechanisms of meaning strengthening, and explain how this account solves the empirical challenges raised in Section 3. Finally, I conclude in Section 5 by reflecting on the scope of this paper for the study of partitives and, more generally, for the study of presuppositionally enriched meanings.

2. The Proper Partitivity Hypothesis

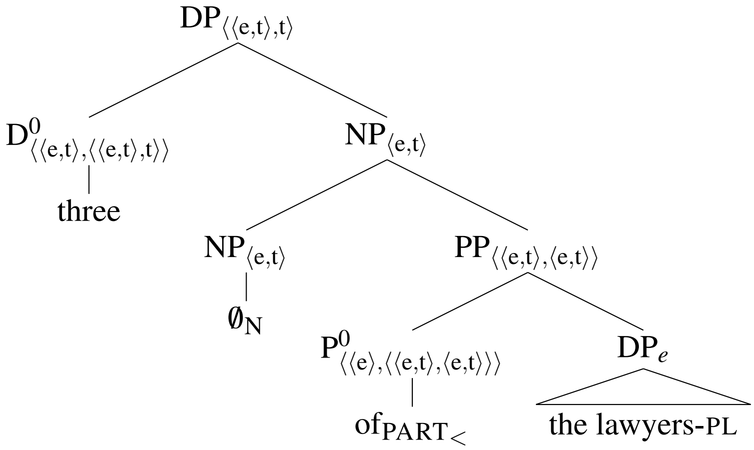
The PROPER PARTITIVITY view on partitives hypothesizes that partitive nominal phrases have in their extension only proper subparts of the entity denoted by the DP within their *of*-phrase. One striking appeal of this view is that it offers to kill two birds with one stone: in addition to account for the proper partitivity effects we are primarily interested in, this view is also argued to account for the long-standing observation that cardinal partitives may not appear with a definite determiner unless modified (a.o., Jackendoff, 1968), as exemplified in (6).

(6) *Anti-Definiteness Effects*
  a. *John met the one/two/three of Mary's lawyer.
     cf. John met Mary's lawyer.
  b. *John met the one/two/three of Mary's lawyers.
     cf. John met one/two/three of Mary's lawyers.

To understand how these results are obtained, let us go over the specifics of Barker's (1998) proposal.[3] On the syntactic side, Barker assumes that the structure of a partitive like *three of the lawyers* is as shown in (7). On this representation, partitives of the surface form *Det of Det NP* contain a phonetically silent nominal, and the *of*-phrase is analyzed as an NP modifier.[4]

[3] Barker (1998) and Zamparelli (1998) offer two contemporary and very similar implementations of the PROPER PARTITIVITY view. For time reason, however, I will restrict the following discussion to Barker's (1998) proposal.
[4] The hypothesis of a silent NP in partitives originates in the pioneer works of Jackendoff (1977), Ladusaw (1982) and Hoeksema (1984), and has received since then substantial empirical support (see Sauerland and Yatsushiro, 2004, 2017). In particular, it accounts for the possibility to extract the *of*-phrase out of the partitive DP, e.g., *Of the seventeen passengers, three/many/only a few survived.* On Barker's view, this silent noun, $\emptyset_{\text{N}}$, is interpreted anaphorically as referring to the set expressed by the embedded NP in the *of*-phrase. Technically, this is achieved by treating $\emptyset_{\text{N}}$ as a semantically transparent nominal with the following denotation: $[[\emptyset_{\text{N}}]] := \lambda x \in D_e.\ (x = x)$. A more common way to implement this idea consists in analyzing the silent NP as a full NP that has undergone deletion at PF, as originally proposed in Jackendoff (1977). See also footnote 11 below for discussion.

(7)



The semantic composition of the partitive NP in (7) involves first some general considerations about the interpretation of plural definites. For our purposes, we can take singular count nouns (e.g., *lawyer*) to denote sets of atomic individuals, and plural count nouns (e.g., *lawyers*) to denote sets that include atomic and non-atomic individuals. On this assumption, the contribution of the plural morphology, noted PL here, corresponds to a sum-closure operation on sets of atomic individuals similar to Link's (1983) *-operator, (8). Applying the denotation of plural-marking to a lexical predicate like *lawyer* gives us a function which is true of either an atomic individual, or a sum of individuals as long as all its atomic parts are lawyer-atoms.

(8) $[[\mathrm{PL}]] := \lambda P \in D_{\langle e,t\rangle}.\lambda y \in D_e.\ \forall x(atom(x) \wedge x \leq y \rightarrow P(x) = 1)$

Next, the definite determiner can be defined as a kind of maximality operator, (9): it is only defined for predicates for which there is a maximal individual all of whose parts make that predicate true; whenever defined, it returns that maximal individual (Sharvy, 1980; Link, 1983). Note that, in case the relevant predicate is only true of atomic individuals, for instance when applied to a predicate like *lawyer*, the definite determiner presupposes then that there is a unique atomic individual that makes that predicate true and delivers that one atomic individual.

(9) $[[\mathrm{the}]] := \lambda P \in D_{\langle e,t\rangle} :\ \exists! x(P(x) \wedge \forall y(P(y) \rightarrow y \leq x)).\ \iota x(P(x) \wedge \forall y(P(y) \rightarrow y \leq x))$

Finally, as in most analyses of partitives, the partitive component is directly incorporated into the semantics of of_{PART}. However, as we have already seen, what is specific to the PROPER PARTITIVITY view is the claim that of_{PART} encodes the irreflexive 'proper-part' relation:

(10) $[[\mathrm{of}_{\mathrm{PART}_<}]] := \lambda x \in D_e.\lambda P \in D_{\langle e,t\rangle}.\lambda y \in D_e.\ (P(y) \wedge y < x)$ (Barker, 1998: (34))

Putting all these pieces together, the semantic computation of the partitive NP in (7) goes as illustrated in (11) (setting aside the presuppositional level for simplicity). In short, in a model where the predicate *lawyer* only has three atomic individuals *a*, *b* and *c* in its extension, the partitive NP denotes the set $\{a,b,c,a\oplus b,a\oplus c,b\oplus c\}$, which corresponds to the set of lawyer-individuals that are proper parts of the maximal lawyer-individual, namely $a\oplus b\oplus c$.

(11) a. $[[\mathrm{lawyer}]] = \{a,b,c\}$
b. $[[\mathrm{lawyers\text{-}PL}]] = \{a,b,c,a\oplus b,b\oplus c,a\oplus c,a\oplus b\oplus c\}$
c. $[[\mathrm{the\ lawyers\text{-}PL}]] = a\oplus b\oplus c$
d. $[[\mathrm{of}_{\mathrm{PART}_<}\ \mathrm{the\ lawyers\text{-}PL}]] = \{a,b,c,a\oplus b,b\oplus c,a\oplus c\}$
e. $[[\emptyset_{\mathrm{N}}\ \mathrm{of}_{\mathrm{PART}_<}\ \mathrm{the\ lawyers\text{-}PL}]] = \{a,b,c,a\oplus b,b\oplus c,a\oplus c\}$

With this in mind, we can turn to how this proposal intends to explain the proper partitivity and the anti-definiteness effects. Consider first the sentence in (12), which gives rise to the proper-part inference that the relevant set of lawyers counts more than three individuals:

(12) *Proper Partitivity Effects à la Barker (1998)*
Three of the lawyers showed up.
a. SS: [[three [$\emptyset_{\mathrm{N}}$ [of$_{\text{PART}_<}$ [the lawyers-PL]]]] [showed up]]
b. Assertion: $\exists x(\#x = 3 \wedge x < [[\text{the lawyers-PL}]] \wedge [[\text{showed up}]](x))$
i.e., there is an individual x made up of 3 atomic individuals such that x is a proper part of the maximal lawyer-individual and x showed up.

The proper-part inference we are interested in is logically entailed by (12): the truth of (12) entails that there is a plural individual made up of three atomic parts that is a proper part of the maximal lawyer-individual, and therefore that the maximal lawyer-individual denoted by the plural definite counts more than three atomic parts. Hence, this analysis accounts for the proper-part inference associated with (12) and, subsequently, for the oddness of sentences like *#Two of John's parents showed up* in run-of-the-mill contexts: if it is common knowledge that everyone has at most two (biological) parents, then the proper-part entailment of this sentence (i.e., that John's parents are at least three) leads to a contextual contradiction, hence the oddness.

Turning next to the anti-definiteness effects, consider now the sentence in (13), which is the definite variant of the previous example; for exposition purpose, (13) follows Barker's (1998) assumptions in treating 'the three' as a complex definite determiner with its own lexical entry.

(13) *Anti-Definiteness Effects à la Barker (1998)*
*The three of the lawyers showed up.
a. SS: [[the three [$\emptyset_{\mathrm{N}}$ [of$_{\text{PART}_<}$ [the lawyers-PL]]]] [showed up]]
b. Presupposition: $\exists! x(\#x = 3 \wedge x < [[\text{the lawyers-PL}]])$
i.e., there is a unique individual x made up of 3 atomic individuals such that x is is a proper part of the maximal lawyer-individual.

Barker proposes that the incompatibility of these partitive NPs with the definite determiner results from the false triviality that arises from the composition of their respective meanings: since any countable entity has by definition either no proper part made up of n atomic elements or else more than one, the presuppositions (of both existence and maximality) carried by these definite descriptions can never be satisfied all together, hence their deviance. On this proposal, proper partitivity and anti-definiteness effects should be thus thought of as having one and the same source, namely the irreflexive proper-part relation expressed by of$_{\text{PART}}$.

To summarize, the PROPER PARTITIVITY view hypothesizes that partitive *of* encodes the proper-part relation and, in so doing, provides an account of two sets of otherwise puzzling facts concerning partitives: (i) the referent of the whole partitive DP is readily interpreted as a proper part of the referent of the embedded one, and (ii) cardinal partitives are deviant with the definite determiner. In the following section, I present yet several issues for this view which will lead me to reject its two key claims, first the claim that proper partitivity and anti-definiteness effects are to be accounted for in a uniform way, and then the very idea that proper partitivity is lexically encoded in the semantics of partitives.

3. Empirical Challenges

3.1. Distribution of the anti-definiteness and proper partitivity effects

On Barker's (1998) proposal, anti-definiteness and proper partitivity effects are hypothesized to follow from the same source, namely from the proper-part implication of of_{PART}, and consequently these effects are expected to have the same distribution. In particular, it is predicted that, for any properly partitive phrase α, the definite variant of α should be deviant. However, this prediction is not empirically borne out. In the count domain, we observe for instance that pronominal partitives like *three of them*, involving a pronominal form in place of the embedded description, pattern like genuine cardinal partitives as far as the proper partitivity effects are concerned, (14a), and yet are exempt from anti-definiteness effects, (14b).[5]

(14) *Pronominal Partitives*
a. Three of them were sick.
$\rightsquigarrow$ *'them' counts more than three atomic individuals*
(cf. Sue, Peter and Mary didn't show up today: #three of them were sick)
b. The three of them were sick.
$\Rightarrow$ *'them' counts exactly three atomic individuals*

Similarly, in the mass domain, we observe that measure partitives like *two hours of John's spare time*, involving a measure phrase and a definite noun phrase indicating what is measured, give rise to proper partitivity effects, (15a), and yet their definite variants are grammatical, (15b).[6]

(15) *Measure Partitives*
a. John spent two hours of his spare time sleeping.
$\rightsquigarrow$ *John had more than two hours of spare time*
(cf. John only had two hours of spare time yesterday: #he spent two hours of his spare time sleeping)
b. John spent the two hours of his spare time sleeping.
$\Rightarrow$ *John had exactly two hours of spare time*

Finally, we note that genuine cardinal partitives like *three of John's lawyers*, although incompatible with the definite determiner, are nonetheless compatible with other maximality-inducing expressions such as *all*, (16).[7] On the plausible assumption that the instance of of_{PART} in these constructions is the same as in their *all*-less versions, the PROPER PARTITIVITY view also incorrectly predicts that these constructions should be deviant or, at any rate, that speakers should continue to get a proper part inference, contrary to facts.

(16) All three of John's lawyers were sick.
$\Rightarrow$ *John has exactly three lawyers*

The take-home message of these observations is thus twofold. First, the naturalness and the interpretation of the partitive constructions in (14b), (15b) and (16) are incompatible with a

[5]The paradigms in (14) and (15) are modeled after examples (39b) and (40b) in Ionin et al. (2006), to whom I owe the observation that the PROPER PARTITIVITY view incorrectly rules out the definite partitives in (14b) and (15b).
[6]Following the previous literature, I assume here that measure partitives like those in (15) involve a meaningful instance of partitive *of*, and are thus to be distinguished from pseudo-partitives (e.g., *two hours of spare time*); see Selkirk (1977), Ladusaw (1982), Krifka (1989), Schwarzschild (2002), among others, for discussion.
[7]I thank Alan Bale and Brian Buccola for discussing the data in (16) with me.

proper-part analysis of of_{PART}. Second, in addition to be distinct in nature, anti-definiteness and proper partitivity effects also have different distributions. Overall, the present data suggest that both kinds of phenomena have in fact distinct sources and that, in all likelihood, the anti-definiteness effects should receive an independent, grammatical explanation, as proposed for instance in Marty (2017).[8] It is thus without loss of generality that the remainder of this paper will focus on describing and capturing the linguistic signature of the proper-part inferences.

3.2. Linguistic signature of the proper-part inferences

3.2.1. Projective behavior and not-at-issue content

Proper-part inferences present certain characteristics that are reminiscent of presuppositions: (i) their distribution parallels that of 'presupposition projection' effects and (ii) their contribution is not at-issue. To establish the first point, consider the examples in (17) and (18), where the description *John's four lawyers* and the partitive *three of John's lawyers* first appear in a declarative sentence and then embedded in a yes/no question, one of the embedding environments from which presuppositions are expected to project.

(17) a. Sue talked to John's four lawyers. $\Rightarrow$ *John has (exactly) four lawyers*
b. Did Sue talk to John's four lawyers? $\Rightarrow$ *John has (exactly) four lawyers*

(18) a. Sue talked to three of John's lawyers. $\rightsquigarrow$ *John has more than three lawyers*
b. Did Sue talk to three of John's lawyers? $\rightsquigarrow$ *John has more than three lawyers*

We observe here that, just like the presupposition in (17), the proper-part inference in (18) can readily survive embedding under question: in a way similar to (17b), the question in (18b) is reliably taken to convey that John has more than three lawyers and to signal that this information is not questioned, but rather taken as granted by the speaker. Similar observations hold for the examples in (19) and (20), where the relevant expressions are now embedded in the antecedent of a conditional, a position from which presuppositions can project unharmed.

(19) If Sue talked to John's four lawyers, then the trial can begin.
$\Rightarrow$ *John has (exactly) four lawyers*

(20) If Sue talked to three of John's lawyers, then the trial can begin.
$\rightsquigarrow$ *John has more than three lawyers*

The second point is evidenced by the following two observations. First, as for genuine presuppositions, speakers may use a *Hey, wait a minute!* response to call into dispute the contribution of a proper-part inference; by contrast, expressions of negation or disagreement, which are generally linked to acceptance of not-at-issue contents, cannot be felicitously used to achieve this same purpose (see von Fintel (2004) and George (2008) for discussion of this test).[9]

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[8] Building upon Ionin et al.'s (2006) observations, Marty (2017) proposes that the anti-definiteness effects follow from a general economy constraint on structural complexity. In substance, definite cardinal partitives like **the three of the lawyers* are ungrammatical because the meaning they express on their non-strict 'part-of' semantics is logically equivalent to that expressed by their structurally simpler non-partitive definite alternatives, i.e., *the three lawyers*. This account is shown to predict the grammaticality of definite pronominal and measure partitives.

[9] Some speakers may find the *Hey, wait a minute!* reply in (17a) slightly more natural than the one in (18a). As we shall later see, such variations are expected if the proper-part inference in (18a), unlike the plain existential presupposition in (17a), arises as an implicature which, upon contextual demands, can be weakened or suspended.

(17a) Sue talked to John's four lawyers.
a. Hey, wait a minute! I didn't know John had more than three lawyers.
b. #No, I disagree! John only has three lawyers.

(18a) Sue talked to three of John's lawyers.
a. Hey, wait a minute! I didn't know John had more than three lawyers.
b. #No, I disagree! John only has three lawyers.

Second, the contribution of proper-part inferences cannot easily be targeted by a negation in discourse, (21a). In that respect, these inferences behave much like presuppositions, (21b), and unlike mere conjuncts, (21c) (see Potts (2005) and Schlenker (2010) for discussion of this test).

(21) *The contribution of proper-part inferences is not at issue*
a. A: Sue talked to three of John's lawyers. B: No!
$\rightsquigarrow$ John has more than three lawyers
b. A: Sue talked to John's four lawyers. B: No!
$\rightsquigarrow$ John has (exactly) four lawyers
c. A: John has more than three lawyers and Sue talked to them. B: No!
$\not\rightsquigarrow$ John has more than three lawyers

These observations raise an issue for Barker's (1998) proposal: in case where partitives are embedded in a downward-entailing environment as in (18b) and (20), proper-part inferences are predicted to remain embedded, hence delivering readings that are intuitively too weak. The additional case in (22) offers a simple illustration of this issue:

(22) *Partitives embedded under negation*
It is not the case that Sue talked to three of John's lawyers.
a. Predicted: $\neg$(*John's lawyers are more than three* $\wedge$ *Sue talked to three of them*)
b. Observed: (*John's lawyers are more than three*) $\wedge\neg$(*Sue talked to three of them*)

In (22), the partitive *three of John's lawyers* is embedded under negation, a downward-entailing environment from which presuppositions can project. Barker's (1998) proposal predicts this sentence to have the reading in (22a), and thus to be felicitous and true in a situation where John is known to have exactly three lawyers and where Sue talked to the three of them. Yet speakers consistently judge (22) as infelicitous in such situations, and report instead a reading along the lines of (22b), where the target proper-part inference is outside the scope of negation.

These observations teach us that proper-part inferences are not part of the asserted content of partitives; rather, these inferences pattern much like presuppositions regarding both their distribution and their conversational status. While the subgeneration issues we pointed out could be addressed by turning Barker's (1998) proper-part requirement into a plain presupposition, it is worth emphasizing that this move would still face the problems discussed in 3.1. The next section discusses further examples where such a move would also lead to overgeneration issues in predicting felicity conditions that are stronger than empirically attested.

3.2.2. Sensitivity to speakers' epistemic state and semantic strength

Proper-part inferences also have certain features which are characteristic of conversational implicatures: (i) their generation is sensitive to the speakers' epistemic state, and (ii) their semantic strength depends upon that of the presupposition of competing sentences. To begin with, we observe that a partitive α can be felicitously used in contexts where the speaker is known to be ignorant as to whether α is properly partitive, showing that these inferences can be suspended. The following contrast establishes this point:

(23) a. OPINIONATED SPEAKER
I know exactly how many lawyers John hired, and I know for sure that [three of his lawyers/three of them] graduated from Harvard.
$\rightsquigarrow$ *John's lawyers are more than three*

b. IGNORANT SPEAKER
I can't remember whether John hired four or only three lawyers, but I know for sure that [three of his lawyers/three of them] graduated from Harvard.
$\not\rightsquigarrow$ *John's lawyers are more than three*

In (23a), we are told that the speaker is opinionated about the number of lawyers John hired, and we spontaneously conclude from his utterance that the speaker is taking for granted that John hired more than three lawyers. In (23b), by contrast, we are told that the speaker is ignorant regarding the exact number of lawyers John hired, and we conclude instead that the speaker is agnostic as to whether John hired exactly three or more than three lawyers. Yet we observe that the discourse in (23b) is fully felicitous. This observation is incompatible with the idea that of_{PART} would semantically express, presuppositionally or assertively, the proper-part relation.

Second, we observe that, for a given sentence *S*, the semantic strength of the proper-part inference associated with *S* depends upon the presuppositional strength of minimally different sentences competing with *S*. Consider the following example:

(24) *Bound partitives in the scope of universals*
Every prisoner$_x$ talked to three of his$_x$ lawyers.

a. $\Rightarrow$ *every prisoner has (at least) three lawyers* — plain presupposition
b. $\rightsquigarrow$ *every prisoner has more than three lawyers* — possible, predicted
c. $\rightsquigarrow$ *not (every prisoner has exactly three lawyers)* — possible, unpredicted

In (24), the partitive *three of his$_x$ lawyers* is embedded in the scope of a universal quantifier: the pronoun *his$_x$* is bound by the subject *every prisoner* and, as it seems, the VP carries the presupposition that *x has (at least) three lawyers* which projects universally across the subject. Crucially, if partitive *of* were expressing the proper-part relation, the sentence in (24) should entail (24b) and thus this sentence should be perceived as odd when uttered in a context where (24b) is known to be false. Yet the felicity of the example in (25) proves this prediction wrong.[10]

(25) *Context: Some prisoners have more than three lawyers, others only three*
Every prisoner$_x$ talked to three of his$_x$ lawyers. Even John$_y$ talked to his$_y$ three lawyers.
(cf. #Every prisoner$_x$ talked to his$_x$ three lawyers)

Instead, as previously noted in Sauerland and Yatsushiro (2004: footnote 6), it appears that the sentence in (24) licenses a weaker proper-part inference of the form in (24c), i.e., that not every prisoner has exactly three lawyers, which intuitively corresponds to the negation of the (stronger) presupposition carried by the minimally different sentence *Every prisoner$_x$ talked*

[10] I refer the reader to Marty (2017) for discussion of related facts regarding the interpretation of bound partitives in the restrictor of universals, where the proper-part analysis of of_{PART} is also found to make incorrect predictions.

to his$_x$ three lawyers. And indeed, as illustrated in (26), we find that sentences like (24) are perceived as odd precisely in those contexts where (24c) is known to be false and where, in comparison to (25), speakers could felicitously utter the relevant competing sentence.

(26) *Context: Every prisoner has three and only three lawyers*
#Every prisoner$_x$ talked to three of his$_x$ lawyers.
(cf. Every prisoner$_x$ talked to his$_x$ three lawyers)

These observations allow us to extend our initial paradigm to the one in (27) by emphasizing some of our core observations. First, the felicitous use of partitives is subject to a weaker requirement than previously thought: although an utterance of *Sue talked to three of John's lawyers* may convey that John has more than three lawyers, it only requires to be felicitous that it be not taken for granted that John has exactly three lawyers. Next, the semantic force and distribution of the proper partitivity effects are predictable from the strength and satisfaction of the presuppositions carried by their definite alternatives, e.g., partitives are infelicitous whenever the (stronger) presuppositions expressed by these competing expressions are known to hold.

(27) *Conditions on the felicitous use of partitives* — *Common Ground:*
a. John hired only three lawyers and ... — $|$*John's lawyers*$| = 3$
(i) #Sue talked to [three of John's lawyers/three of them]
(ii) Sue talked to [John's three lawyers/the three of them]
b. John hired four lawyers and ... — $|$*John's lawyers*$| > 3$
(i) Sue talked to [three of John's lawyers/three of them]
(ii) #Sue talked to [John's three lawyers/the three of them]
c. I don't know if John has three or four lawyers, but ... — $|$*John's lawyers*$| \geq 3$
(i) Sue talked to [three of John's lawyers/three of them]
(ii) #Sue talked to [John's three lawyers/the three of them]

The bulk of our data demonstrates that the source of proper partitivity cannot lie in the plain logical meaning of partitives, and reveals instead that the proper-part inferences associated with these constructions have the linguistic signature of the so-called 'implicated presuppositions' (Sauerland, 2008). In the next section, I move back to the only analytical option that remains, the PARTITIVITY view, and propose that the proper partitivity effects arise as a result of an anti-maximality implicature on the basis of the general competition between indefinites and their presuppositionally stronger definite alternatives.

4. Deriving Proper Partitivity from Partitivity and Scalar Reasoning

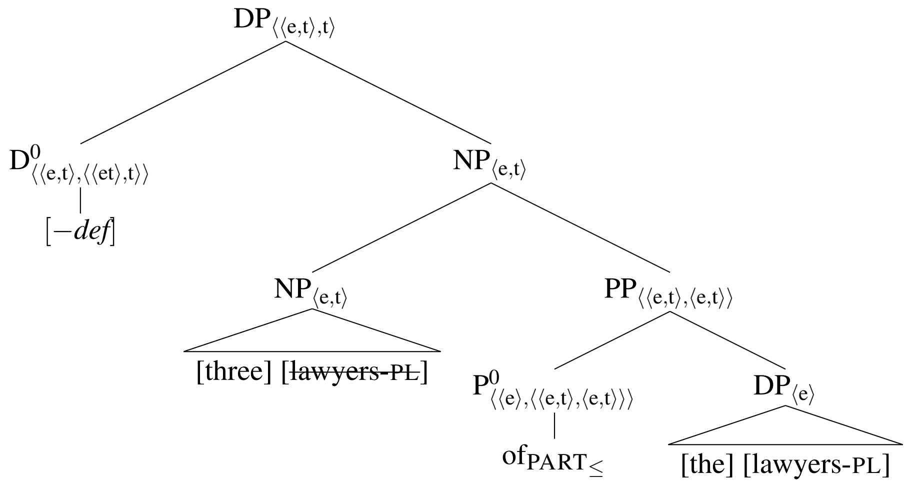
4.1. Plain ingredients of partitives

Following the PARTITIVITY hypothesis, I propose that *of*$_{\text{PART}}$ semantically encodes the part-of relation and that this relation is expressed both at the presuppositional and assertion level:

(28) $[[\text{of}_{\text{PART}_{\leq}}]] := \lambda x \in D_e.\lambda P \in D_{\langle e,t\rangle}.\lambda y \in D_e : (P(y) \wedge y \leq x).\ (P(y) \wedge y \leq x)$

As far as the composition of partitives goes, my assumptions are very much in line with Barker (1998) and the previous literature (a.o., Jackendoff, 1977; Hoeksema, 1984; Schwarzschild, 2002; Sauerland and Yatsushiro, 2004; Ionin et al., 2006; Sauerland and Yatsushiro, 2017):

(29)



The only noticeable aspect on which I differ from Barker (1998) concerns the treatment of cardinal numerals. In line with Ionin and Matushansky (2005) and Ionin et al. (2006), I will assume that simplex cardinal numerals are lexical heads with an 'adjectival' meaning which requires the predicate they combine with to be a set of individuals divisible into a certain number of atomic parts, e.g., $[[\text{three}]] := \lambda x \in D_e.\ \#x = 3$. In cardinal partitives, these expressions combine with the silent NP that contains the *of*-PP, which I will take here to be a full NP which undergoes deletion at PF.[11] Since cardinal numerals do not have by themselves any quantificational force, I further assume that existential quantification comes about by means of a silent indefinite determiner, noted $[-def]$, whose meaning is akin to that of the indefinite determiner *some* in English: $[[[-def]]] := \lambda P \in D_{\langle e,t\rangle}.\lambda Q \in D_{\langle e,t\rangle}.\ \exists x(P(x) \wedge Q(x))$. On these assumptions, the truth-conditions of a sentence like *three of the lawyers showed up* are as follows:

(30) Three of the lawyers showed up.

a. Presupposition: $\exists x(\#x = 3 \wedge [[\text{lawyers-PL}]](x) \wedge x \leq [[\text{the lawyers-PL}]])$
i.e., there is a maximal lawyer-individual and there is an individual x such that x is made up of three lawyer-atoms and x is part of the maximal lawyer-individual

b. Assertion: $\exists x(\#x = 3 \wedge [[\text{lawyers-PL}]](x) \wedge x \leq [[\text{the lawyers-PL}]] \wedge [[\text{showed up}]](x))$
i.e., there is an individual x such that x is made up of three lawyer-atoms, x is part of the maximal lawyer-individual, and x showed up

In short, (30) presupposes that there is a lawyer-individual who is made up of three atomic lawyer-individuals and who is part of the maximal lawyer-individual. This presupposition obtains by existentially projecting across [−*def*] the presupposition which is carried by $of_{\text{PART}_\leq}$ and subsequently inherited by the partitive NP that [−*def*] composes with. When this presupposition is met, (30) is true if and only if the plural lawyer-individual in question showed up. Consistent with the PARTITIVITY hypothesis, the plain meaning of (30) does not exclude cases of identity where maximality holds. That is, *on its plain meaning*, (30) is predicted to be felicitous and true in a situation where the relevant set of lawyers counts exactly three individuals.

[11] This line of analysis is supported for instance by the observation that the determiners that cannot occur in the higher position of partitives when the NP is silent (e.g., **John didn't talk to the/every/no ~~lawyers~~ of the lawyers*) are precisely those that do not license NP-deletion in English (e.g., **John didn't talk to the/every/no ~~lawyers~~*). This line of analysis is also successful in accounting for cases where one underlying structure allows different surface realizations, including realizations where the usually silent NP is made overt (e.g., *three lawyers of the lawyers that John hired*). See also footnote 4 for references and discussion.

4.2. Competition between indefinite partitives and their definite alternatives

If partitivity is simply partitivity, then why and how are cases of identity ruled out by speakers? I propose that these interpretative effects arise because of the competition between indefinite partitives and their definite alternatives at the presuppositional level, (31): by scalar reasoning, speakers interpret the weak existential presupposition of partitives (e.g., that the lawyers are at least three) as conveying the falsity of the stronger maximality presupposition of their definite alternatives (e.g., the lawyers aren't exactly three), which results in a proper-part inference (i.e., the lawyers are more than three). On this proposal, this competition can be seen as a particular instance of the general competition between indefinite and definite DPs, whose underlying logic has commonly been analyzed along the lines of a principle like *Maximize Presupposition!* (a.o., Heim, 1991; Sauerland et al., 2005; Percus, 2006; Sauerland, 2008; Chemla, 2008; Singh, 2009, 2011; Schlenker, 2012; Lauer, 2016; Leahy, 2016; Rouillard and Schwarz, 2017).

(31) *Indefinite partitives and their definite competitors*
a. Three of the lawyers showed up. — indefinite partitive
b. The three lawyers showed up — definite alternative

To establish this point properly, let us show that, on most (if not all) formulations of *Maximize Presupposition!*, (31b) meet the criteria to qualify as a presuppositional competitor to (31a). First, adopting the notion of *structurally-defined alternatives* proposed in Katzir 2007 (see also Katzir, 2008; Fox and Katzir, 2011), we verify below that (31b) is a formal alternative to (31a): (31b) is derivable from (31a) by substituting the whole partitive NP with its higher NP, (a), and subsequently by substituting the indefinite determiner with its definite counterpart, (b).[12]

(31a) Three of the lawyers showed up.
SS: $[_{\mathrm{DP}}\ [-def]\ [_{\mathrm{NP}_1}\ [_{\mathrm{NP}_2}$ three lawyers-PL] [of$_{\mathrm{PART}}$ [the lawyers-PL]]]] showed up
a. Substitution of NP_1 with its sub-constituent NP_2:
$[_{\mathrm{DP}}\ [-def]\ [_{\mathrm{NP}_2}$ three lawyers-PL]] showed up
b. Substitution of the determiner $[-def]$ with *the*:
$[_{\mathrm{DP}}$ [the] $[_{\mathrm{NP}_2}$ three lawyers-PL]] showed up — = (31b)

Second, it is easy to verify that (31b) is presuppositionally stronger than (31a): if the maximal lawyer-individual counts three atomic parts, then there is an individual made up of three atomic parts that is part of the maximal lawyer-individual (i.e., (32b) entails (32a)), while the reverse is not true (i.e., (32a) doesn't entail (32b)). Finally, note that (31a) and (31b) are Strawson-equivalent: whenever (31a) and (31b) are defined at a world w, i.e., (31a) and (31b) do not yield presupposition failure relative to w, then both sentences have the same truth-value at w.

(32) a. Plain presupposition of (31a):
$\lambda w.\ \exists x(\#x = 3 \wedge [[\text{lawyers-PL}]](x)(w) \wedge x \leq [[\text{the lawyers-PL}]](w))$
b. Plain presupposition of (31b) (simplified):
$\lambda w.\ \exists! x(\#x = 3 \wedge [[\text{lawyers-PL}]](x)(w))$
c. Strawson-equivalence:
$\forall w \in W$, if $[[(31a)]]$ and $[[(31b)]]$ are defined at w, then $[[(31a)]](w) = [[(31b)]](w)$

[12]In short, the set of structural alternatives to a sentence ϕ, noted $\mathrm{ALT}_{str}(\phi)$, is the set of syntactic structures that are derivable from ϕ by a finite series of substitutions in ϕ, and that are therefore *structurally at most as complex as* ϕ: $\mathrm{ALT}_{str}(\phi) := \{\psi : \psi \lesssim \phi\}$. See Katzir (2007: (18)-(20)) for formal definitions and discussion.

To the best of my knowledge, the competition at work in (31) extends to all other cases of indefinite partitives discussed in this paper, including pronominal and measures partitives, whose definite alternatives are easier to identify in the absence of anti-definiteness effects, (14)-(15). Furthermore, it is worth noting that, on the non-strict 'part-of' semantics we adopted, the grammaticality and the maximal-interpretation of the (b)-sentences are now fully expected.[13]

(14) *Pronominal Partitives*

a. [[$-def$] three of them] were sick.
$\Rightarrow$ *them* counts at least three atomic parts

b. [[the] three of them] were sick.
$\Rightarrow$ *them* counts three and only three atomic parts

(15) *Measure Partitives*

a. John spent [[$-def$] two hours of his spare time sleeping]
$\Rightarrow$ John had at least two hours of spare time

b. John spent [[the] two hours of his spare time sleeping]
$\Rightarrow$ John had two and only two hours of spare time

On current approaches to presuppositional implicatures, the output of these competitions is predicted to be twofold: (1) the use of an indefinite partitive can convey that the maximality presupposition of its definite alternative is taken to be false, and (2) the use of an indefinite partitive is felicitous only if it is not common ground that the maximality presupposition of its definite alternative holds. Our core observations can be shown to follow from these predictions.

4.3. Presuppositional scalar strengthening: a possible implementation

To explain the derivation of anti-maximality inferences in further detail, let us assume for the sake of explicitness that presuppositional scalar strengthening can be captured in terms of an exhaustivity operator, notated EXH^{prs}, which is attached to the matrix level of every sentence. Capitalizing on various insights from the previous literature on presuppositional implicatures, this operator can be defined for our purposes as in (33). Notation-wise, 'S_p' stands for any sentence S carrying presupposition p, '$\text{IE}^{prs}(S_p)$' stands for the set of innocently excludable presuppositional alternatives to sentence S_p, and $\mathscr{H}$ stands for the predicate *harmless*.

(33) *Presuppositional Scalar Strengthening (in a nutshell)*

a. $\text{E}^{prs}(S_p) = \{S_q$: S_q is a structural alternative to S_p & S_q is presuppositionally stronger than S_p & S_q is Strawson-equivalent to $S_p\}$

b. $\text{IE}^{prs}(S_p,\Sigma) = \bigcap \left\{ \Sigma' \;\middle|\; \begin{array}{l} \Sigma' \subseteq \Sigma \text{ and } \Sigma' \text{ is a maximal subset of } \Sigma \\ \text{such that } \{\neg q : S_q \in \Sigma\} \cup \{S_p\} \text{ is consistent} \end{array} \right\}$

c. Harmless presupposition: presupposing q is *harmless*, that is $q \in \mathscr{H}$, as long as q is non-controversial and non-critical to the purpose of the conversation; presupposing q is *trivially harmless* at a context c if c entails q.

d. $[[\text{EXH}^{prs}\ \text{S}_p]](w) = p(w) \wedge \forall S_q(q \in \mathscr{H} \wedge S_q \in \text{IE}^{prs}(S_p, \text{E}^{prs}(S_p)))[\neg q(w)].\ S(w)$

[13]I refer the reader to Marty (2017) for a complete description of the cases in (14)-(15) as well as for discussion of additional ones such as double genitives (a.k.a. partitive possessives), e.g., *Three (lawyers) of John's (lawyers) showed up*, which are argued to have the same definite structural alternatives as genuine cardinal partitives, i.e., *John's three lawyers*, derivable from very similar substitution operations as those described here.

In substance, $[\text{EXH}^{prs}\ \text{S}_p]$ is defined only if (a) p is true and (b) for every innocently excludable presuppositional competitor S_q to S_p such that presupposing q is *harmless*, q is false. To explain how this mechanism of presuppositional strengthening works, let us consider the case of singular indefinites. So suppose that the sentence S_p in (34), which EXH^{prs} is attached to, is uttered in a context in which the differential maximality presupposition q of its definite alternative is *harmless*, then $[\text{EXH}^{prs}\ \text{S}_p]$ will presuppose that the company has a lawyer (i.e., the presupposition p) but not a unique one (i.e., the presuppositional implicature $\neg q$).

(34) $[\text{EXH}^{prs}\ [_{S_p}$ Sue talked to a lawyer of$_{\text{POSS}}$ the company$]]$
   a. $[\![[_{S_p}$ Sue talked to a lawyer of$_{\text{POSS}}$ the company$]]\!]$
   $= \lambda w :$ *the company has a lawyer in w. Sue talked to a lawyer of the company in w*
   b. $[\![[_{S_q}$ Sue talked to the lawyer of$_{\text{POSS}}$ the company$]]\!]$
   $= \lambda w :$ *the company has a unique lawyer in w. Sue talked to the lawyer of the company in w*
   c. $[\![\text{EXH}^{prs}\ [S_p]]\!]$ is defined at a world w only if
   $(\textit{the company has a lawyer in } w) \wedge \neg(\textit{the company has a unique lawyer in } w)$
   $\Rightarrow (\textit{the company has at least two lawyers in } w)$

As illustrated in (35), this mechanism of presuppositional strengthening derives the proper-part inferences associated with indefinite partitives through a similar kind of scalar reasoning:

(35) $[\text{EXH}^{prs}\ [_{S_p}$ Sue talked to three of$_{\text{PART}}$ the lawyers$]]$
   a. $[\![[_{S_p}$ Sue talked to three of$_{\text{PART}}$ the lawyers$]]\!]$
   $= \lambda w :$ *the lawyers are at least three in w. Sue talked to three of the lawyers in w*
   b. $[\![[_{S_q}$ Sue talked to the three lawyers$]]\!]$
   $= \lambda w :$ *the lawyers are exactly three in w. Sue talked to the three lawyers in w*
   c. $[\![\text{EXH}^{prs}\ [S_p]]\!]$ is defined at a world w only if
   $(\textit{the lawyers are at least three in } w) \wedge \neg(\textit{the lawyers are exactly three in } w)$
   $\Rightarrow (\textit{the lawyers are at least four in } w)$

Crucially, this mechanism mimics the effects of *Maximize Presupposition!* in predicting the use of singular indefinites or partitive indefinites to be infelicitous in contexts where the maximality presupposition of its definite alternative is common ground (e.g., #*Sue talked to a mother of John/two of John's parents*). In these contexts, since the relevant differential presupposition q in (34)-(35) is mutually believed by the interlocutors, presupposing q is *trivially harmless* and consequently, the implicatures in (34)-(35) ought to be derived, resulting in representations that directly conflict with common knowledge (i.e., the speaker believes q and $\neg q$). This line of explanation is essentially similar to Magri (2009, 2011, 2014) in explaining oddness in such cases from the obligatory generation of an implicature that clashes with common knowledge.

4.4. Capturing the linguistic signature of proper-part inferences

4.4.1. Projective behavior and not-at-issue content

This analysis straightforwardly captures the projective behavior of proper-part inferences: since presuppositional strengthening is performed on the basis of the plain presuppositions of competing alternatives, these inferences are predicted to be found in any environment where the presuppositions of the relevant competitors are expected to project, regardless of the monotonicity of that environment. To illustrate, consider again the case in (22), and assume that natural negation (notated NOT here) behaves as a hole for presuppositions. On our proposal, S_p and $\neg S_p$ have similar presuppositional alternatives, S_q and $\neg S_q$, which have identical presuppositions, q. Upon strengthening of their presuppositional contents, both sentences deliver the same proper-part inference and therefore end up with the same felicity conditions.

(22) [EXH^{prs} [NOT [$_{S_p}$ Sue talked to three of$_{\text{PART}}$ the lawyers]]]
   a. [[NOT [$_{S_p}$ Sue talked to three of$_{\text{PART}}$ the lawyers]]]
   $= \lambda w :$ *the lawyers are at least three in w.* $\neg$*(Sue talked to three of the lawyers in w)*
   b. [[NOT [$_{S_q}$ Sue talked to the three lawyers]]]
   $= \lambda w :$ *the lawyers are exactly three in w.* $\neg$*(Sue talked to the three lawyers in w)*
   c. [[EXH^{prs} [NOT S_p]]] is defined at a world w only if
   (*the lawyers are at least three in w*) $\wedge \neg$(*the lawyers are exactly three in w*)
   $\Rightarrow$ (*the lawyers are at least four in w*)

On our view, the not-at-issue contribution of these inferences is thus unsurprising since it directly follows from their presuppositional status. It is worth emphasizing however that, since these inferences lie in the generation of an implicature, whose computation can be refrained in some contexts (e.g., when presupposing *q isn't harmless*), the life of these inferences is necessarily more fragile than that of plain presuppositions. As a result, would some uncertainty remain as to whether presupposing q is truly harmless from the speaker's perspective, calling their contribution into dispute would then appear as an unworthy conversational detour.

4.4.2. Sensitivity to the speakers' epistemic state and semantic strength

This analysis captures the context-sensitivity of proper-part inferences through the notion of *harmless presupposition*: a presuppositional implicature $\neg q$ obtains at a context c only if presupposing q at c is *harmless*, e.g., because q is entailed in C or else easy to accommodate. As seen above, this notion accounts for the infelicity of indefinites in contexts where the maximality presupposition q of their alternatives is satisfied and thus *trivially harmless*. We can now observe that this notion also accounts for the felicitous use of indefinites in contexts where the speaker is known to be ignorant regarding the truth of q, as in (23b): because q is now controversial, presupposing q cannot be harmless, and therefore the computation of the implicature associated with q does not go through, hence avoiding any conflict with the common ground.

Finally, for the sake of completeness, we note that a mechanism of presuppositional scalar strengthening in the spirit of the one we have sketched above makes correct predictions concerning the semantic strength of the proper-part inference associated with bound partitives in the scope of universals, (24):

(24) EXH^{prs} [$_{S_p}$ every prisoner$_x$ talked to three of his$_x$ lawyers]
   a. [[[$_{S_p}$ every prisoner$_x$ talked to three of his$_x$ lawyers]]]^g
   $= \lambda w :$ *every p. has at least three lawyers in w. every p. x talked to three of x's lawyers in w*
   b. [[[$_{S_q}$ every prisoner$_x$ talked to his$_x$ three lawyers]]]^g
   $= \lambda w :$ *every p. has exactly three lawyers in w. every p. x talked to x's three lawyers in w*
   c. [[EXH^{prs} [S_p]]] is defined at a world w only if
   (*every p. has at least three lawyers in w*) $\wedge \neg$(*every p. has exactly three lawyers in w*)
   $\Rightarrow$ (*at least one prisoner has at least four lawyers in w*)

In this case, the presuppositional alternative S_q to S_p presupposes that *every prisoner has exactly three lawyers*: conjoining p with the negation of q delivers the enriched presupposition that every prisoner has at least three lawyers and that at least one of them has more than three.

5. Discussion

The idea that *of*$_{\text{PART}}$ simply expresses the 'part-of' relation is far from obvious: it is at odd with our immediate intuitions about the 'properly partitive' meaning conveyed by partitives. Yet this working hypothesis was found to be empirically adequate. For the proper-partitivity puzzle to be solved, the definite competitors to partitives must enter the picture. Once the picture enriched, proper-part inferences can be shown to pattern with other anti-presuppositional effects previously observed in the literature, to be derivable from general mechanisms of meaning strengthening and ultimately to reduce to genuine cases of anti-maximality implicatures. As an attempt to capture the linguistic signature of these inferences on formal grounds, I have sketched out a basic mechanism for presuppositional scalar strengthening which borrows insights from both the pragmatic and the grammatical approach to presuppositional implicatures. While this mechanism was shown to be functional for the cases at hand, a more in-depth discussion of its novelties, like the notion of *harmless presupposition*, is left for future works.

Before closing, let me briefly emphasize two instructive challenges that we have encountered in this study before reaching this simple conclusion. The first one was to shake off the misleading, yet tenacious, intuition that partitives express proper partitivity. As we have explained, there is in fact some empirical basis for the longevity of this impression. Unlike regular scalar implicatures, presuppositional implicatures have a presuppositional source and consequently their presence is pervasive: as long as the environment at hand permits presuppositions to project, these inferences can arise. In that respect, the tests for detecting presuppositionally enriched meanings are harder to come by; in particular, these inferences are left unaffected by certain factors that are known to impact on the generation of regular scalar implicatures such as the monotonicity of the environment. However, one such test seems general enough to cover all scalar strengthening phenomena, the IGNORANCE TEST in (36), which relates to previous observations from Heim (1991) and Sauerland (2008) and which we have implicitly used in 3.2.2. As far as I can tell, this test remains the touchstone for the kind of study we have conducted.

(36) **Ignorance Test**
Let S be any sentence and ϕ be any contingent proposition. If there is a context c in which S can be felicitously uttered by a speaker who is known to be ignorant about the truth of ϕ at c, then ϕ is not entailed by S's logical meaning.

The second challenge was to explain in a principled way how partitive constructions such as *three of the lawyers* relate to their non-partitive definite competitors, i.e., *the three lawyers*. This was achieved in this paper through the synergy of two independent avenues of research: (a) previous works on the syntactic composition of partitives and specifically the empirical corroboration of the hypothesis that these constructions contain silent material (a.o., Jackendoff, 1977; Sauerland and Yatsushiro, 2004, 2017), and (b) previous works contributing to elucidate the grammatical procedures that speakers rely on for deriving the set of alternatives that can enter scalar implicature reasoning (a.o., Katzir, 2007, 2008; Fox and Katzir, 2011).

In addressing both these challenges, the present study offers on the one hand a more fine-grained analysis of the interpretation and use of partitives, and on the other a new case study on the nature of strengthened meanings which, I hope, will contribute to further improve our understanding of the scalar strengthening mechanisms operative in natural languages.

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The case of restricted locatives[1]

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Abstract. This paper examines the cross-linguistic phenomenon of locative case restricted to a closed class of items (L-nouns). Starting with Latin, I suggest that the restriction is semantic in nature: L-nouns denote in the spatial domain and hence can be used as locatives without further material. I show how the independently motivated hypothesis that directional PPs consist of two layers, Path and Place, explains the directional uses of L-nouns and the cases that are assigned then, and locate the source of the locative case itself in p^0, for which I then provide a clear semantic contribution: a type-shift from the domain of loci to the object domain. I then examine cross-linguistic restrictions on the use of locative case and show that the patterns observed can be accounted for on the same assumptions.

Keywords: locative, PP structure, case-assignment, directional, spatial.

1. Introduction

In Latin names of towns, cities, small islands (1a) and a few common nouns (1b) including *domus/domi* 'home', *rus/ruri* 'countryside' and *humus/humi* 'ground' (henceforth, *L-nouns*) can be marked with locative case and used as locative adverbials. All other toponyms and common nouns require a preposition for this purpose, even when appearing in apposition to a locative (1b):[2]

(1) a. iacēre humi (Gildersleeve and Lodge,1876:266)
lie.INF ground.LOC
'to lie on the ground'

b. Mīlitēs Albae cōnstitērunt in urbe opportūnā.
soldiers Alba.LOC halted in city.ABL convenient.ABL
'The soldiers halted at Alba, a conveniently situated town.'

(2) a. Pompeius in Thessaliam pervenit. (Woodcock, 1959:4)
Pompey in Thessaly.ACC arrived
'Pompey arrived in Thessaly.'

b. Me potius in Hispania fuisse tum quam Formiis! (Woodcock, 1959:36)
I.ACC able in Spain.ABL be.PERF.INF then than Formiae.LOC
'To think of my having been in Spain at that time rather than at Formiae!'

Locative case is systematically syncretic with other cells in the paradigm: in the plural it is always identical to ablative, whereas in the singular it coincides with genitive in the first two

[1] Many thanks to the audiences at the *TIN-dag 2015* (February 7, 2015), Frankfurt University (April 30, 2015), *Proper Names Workshop* (CEU, Budapest, May 18-19, 2015), *Séminaire de LaGraM* (Paris 8, June 8, 2015), *Syntax-interface meetings* (Utrecht, September 28, 2015), the "Namengrammatik" workshop, Delmenhorst, March 17-18, 2016), *ComSyn* (Leiden, March 9, 2017) and *Sinn und Bedeutung 23* (Barcelona, September 5-7, 2018), where parts of this research were presented.

[2] Latin examples are given with the spelling conventions adopted by the sources from which they are taken and so long vowels are indicated inconsistently.

declensions and with ablative (or occasionally dative in Old Latin) in the third declension. This syncretism renders it unlikely that there is a morphological restriction on the distribution of the locative case suffix, which would also not explain the semantic restriction on the set of proper names compatible with locative. Furthermore, exactly the same set of lexical items can be used bare as the goal, with accusative case-marking, and as the source, with ablative case-marking (Gildersleeve and Lodge, 1876; Allen et al., 1903; Woodcock,1959; Ernout and Thomas,1964; etc.):[3]

(3) a. Missī lēgātī Athēnās sunt. (Gildersleeve and Lodge ,1876:214)
sent.PL envoys Athens.ACC are
'Envoys were sent to Athens.'

b. Innumerābilēs (philosophī) numquam domum revertērunt.
innumerable philosophers never home.ACC returned
'Innumerable philosophers never returned home'

(4) a. (Verrēs) omnia domō ēius abstulit. (Gildersleeve and Lodge, 1876:249)
Verres everything house.ABL his took.away
'Verres took everything away from his home.'

b. Dolābella Dēlō proficīscitur. (Gildersleeve and Lodge, 1876:251)
Dolabella Delos.ABL depart
'Dolabella sets out from Delos.'

Accusative and ablative case marking is not restricted in any way, since all nouns and proper names have these cells in the paradigm. It is therefore becomes clear that only L-nouns can make use of these cases to function as goals or sources, and the question is why.

The next alternative is that the locative interpretation and the locative case both arise from an underlying preposition. Indeed, two ways of ensuring that this preposition does not appear on the surface can be envisaged. Under one view the relevant preposition is phonologically null, as has been proposed (Emonds, 1976 and Camacho, 1996, though see also Kayne, 2005 and Collins, 2008) for English examples like (5)-(6). Under another view, the preposition conflates in the syntax with the locative-case noun.

(5) a. She wants to move (to) someplace new. (Emonds, 1976)
b. I'm leaving (on) the day after tomorrow.

(6) a. I saw John [$_{NP}$ that day/someplace you'd never guess]. (Larson, 1985)
b. John was headed [$_{NP}$ that way].
c. Max pronounced my name [$_{NP}$ every way imaginable].

Several problems arise with this view. Firstly, the null preposition hypothesis would require the preposition to l-select its complement and would still need to account for the common

[3] The match is not altogether perfect. Accusative can be used for marking goal also with some country names (Woodcock, 1959:4-6), though it seems to be a matter of individual use rather than a generally available option. Likewise, as noted by Woodcock (1959:29-30), for some authors, the bare ablative of source seems to be in free variation with the preposition *ex* 'from'. I leave both issues for future research.

semantics of L-nouns. The same issue arises with the conflation view: why do the nouns that trigger conflation share common semantics?

A further problem with both views is that L-nouns are not incompatible with regular locative prepositions ((7), see also (5)). The choice of using an overt preposition or omitting it is not, however, without semantic consequences: as noted by Allen et al. (1903:270), with city names the use of the overt locative preposition *ab* 'from' and of *ad* 'to' leads to *apud*-locative semantics, with the meanings of 'from the vicinity of' and 'to the vicinity of', respectively:

(7) a. ut a Mutina discederet (Latin sources, via Allen et al. 1903)
so.that from Modena.ABL retire.SBJ
'that he should retire from Modena (which he was besieging)'

b. ad Alesiam proficiscuntur
to Alesia.ACC advance.3PL
'they set out for Alesia'

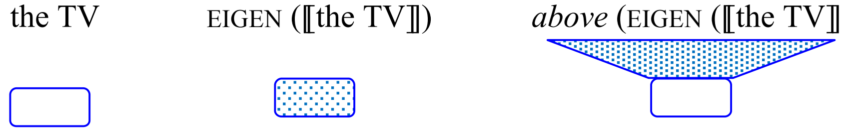
This observed change in the interpretation of the locative prepositions is unexpected under the syntactic accounts. A twofold question arises: why are only L-nouns possible as locatives without a preposition and why do they change interpretation in the presence of an overt preposition? Furthermore, as we will see below (section 5), Latin is not an isolated case: lexical-semantic restrictions on the use of locative cases are cross-linguistically very common. This is also why the solution I propose is based in semantics rather than syntax: I suggest that L-nouns denote in the spatial domain rather than in the entity domain.

2. The core of the solution: the semantics of loci

While there are many technically different approaches to the semantics of spatial prepositions (Bierwisch, 1988; Wunderlich, 1991; Zwarts and Winter, 2000; Kracht, 2002; Bateman et al., 2010; etc.), they all agree that locative prepositions operate in the dedicated domain of loci (regions, sets of points, sets of vectors, etc.; a different domain of paths (e.g., ordered series of loci) has been proposed for directional prepositions), which makes available spatial relations between individuals.

What seems uncontroversial in all these different approaches is that what is minimally needed is a semantic type for loci (for our purposes, type *l*) and a function to map an entity to its locus. The latter, the *eigenspace* of an entity, has been defined by Wunderlich (1991) as the region that the entity occupies (obtained by the application of the primitive function **EIGEN**). A preposition applies to the locus that is the eigenspace of an entity and returns another locus standing in the appropriate spatial relation to it:[4]

(8) the TV EIGEN (⟦the TV⟧) *above* (EIGEN (⟦the TV⟧))



[4] This description is necessarily simplified. It is more likely that EIGEN forms part of the meaning of a spatial preposition rather than an independent syntactic node or type shift. Evidence for this comes from prepositions like the Dutch *voor* 'in front of', which require access to the object. Prepositions can introduce additional restrictions (e.g., *on* requires contact rather than orientation) and may relate not to the object itself but only to its (relevant) boundaries (cf. Matushansky and Zwarts, 2017). But for our present purposes this is good enough.

Once it is established that there is a domain that deals with loci and their relationships to each other, it is natural to assume that noun phrases can do so as well. Evidence in favor of this view comes from Creary, Gawron, and Nerbonne (1989), who observe, following the insight of Jackendoff (1983) (see also Larson, 1987), that arguments and locatives behave very similarly where it comes to reference and quantification. Just like object-denoting arguments can be pronominalized, quantified over and give rise to ACD, so can locatives, and hence there are at the very least demonstratives and QPs that denote in this domain:

(9) a. Bill sang **everywhere** Mary sang/did.
b. Al lives *on the Ohio*, and Ed works **there**.
c. Al lives *on the Ohio in Kentucky*, and Ed works **there**.

However, if an NP already denotes a locus, the (locative) preposition is not necessary, and this is, I claim, precisely what happens in Latin. In other words, I propose that it is by virtue of their interpretation as loci rather than objects that L-nouns can appear as locative modifiers without a preposition (or any other mechanism for the appropriate externally assigned theta-role, cf. Emonds, 1987; Barrie and Yoo, 2017) and that the assignment of locative case arises as the result of this environment. Conversely, other, regular nouns denote in the object domain, which means that they cannot appear in that syntactic environment and therefore cannot be assigned locative case in principle. As a result, we limit the variation to the lexicon (all and only nouns that denote in the locative domain can function as locative adverbials without a preposition) and reestablish the classical view of case as reflecting the syntactic environment in which the noun phrase finds itself. We furthermore naturally account for the fact that L-nouns form a closed lexical-semantic class and account for R-pronouns (e.g., *here*, *there*) as demonstratives denoting in the spatial domain, which also explains why they have the syntax of PPs rather than adverbials (Burton-Roberts, 1991).

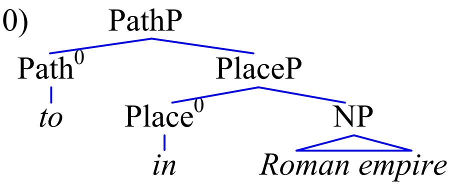
Additional evidence in favor of treating L-nouns as not denoting in the object domain comes from the fact, noted by Donaldson (1860:314), that restrictive modification generally blocks the ability of the L-noun *domum* 'home/house' to function as a bare locative (e.g., *in domo regali* 'in a royal house'). The contrast is not as sharp as one would have desired, since non-restrictive modification does not remove the ability to function as a locative (cf. *meae domī* 'at my home' (Plautus, *Aulularia* 432 via Calabrese (2008)); *proximae viciniae habitat* 's/he lives nearby' (Plautus, *Bacchidae* 2, 2, 27)), yet it is definitely suggestive.

An alternative to the locus denotation of L-nouns is Kayne (2005), who claims that English locative adverbials should be derived from a more complex structure (*~~this~~ here ~~PLACE~~*). Conversely, Collins (2008) proposes (cf. Katz and Postal,1964, but also Larson,1985) that R-pronouns can also occur as complements of a null preposition, thus accounting for their bare uses, as in (9), and extends both hypotheses to the bare use of *home* and the light locative *place*. I believe, however, that this line of reasoning is on the wrong track and the starting point should be exactly the opposite one: namely, that it is due to their semantics as loci (spatial entities) that R-pronouns can be used without additional structure as locative adverbials and that similar locative use of items like *place* and *home* should be attributed to a change in their semantics. Clear evidence in favor of my proposal and against the views attributing a complex structure to locative demonstratives comes from French, where locative pronouns *en* and *y* are clitics, which necessarily entails that they are syntactically simplex.

3. Paths and directionals

Having established the fact that there can be locus-denoting nouns in a language, we can now turn to the directional uses of bare L-nouns in Latin: the ablative and the allative. To account for them, I will appeal to the hypothesis defended, among many others, by Jackendoff (1983), Bierwisch (1988), Koopman (2000), Tungseth (2003) and Zwarts (2005) that directional PPs are more complex (semantically and syntactically) than locative ones. The general consensus about the relation between locative and directional PPs is sketched in (10) and supported by the morphological structure of locative adpositions and cases (see, e.g., Zwarts, 2010):

(10) (general consensus)



An appeal to Path^0 can explain the phenomenon of directional/locative case alternation in Indo-European (Bierwisch, 1988; den Dikken, 2003, 2010; Zwarts, 2005, 2006; Lestrade, 2006, 2010; Caha, 2010, among others), which consists, in Latin as in other languages, of the semantically conditioned case marking with certain prepositions. For instance, as shown in (11) for Latin, when the PP *under Roman rule* functions as a locative adverbial, the NP is marked ablative, whereas when it is a goal, the NP is accusative. In German, exemplified in (12), locative PPs involve dative case, and in Russian ((13)-(14)), locative or instrumental, in function of the preposition. Whereas the ablative, dative, locative and instrumental cases here can reasonably be attributed to Place^0, it is the allative Path^0 that is responsible for the case in their directional counterparts. The directional case that was originally assigned there became syncretic with accusative as a result of the historical development of Indo-European case morphology (cf., e.g., Meier-Brügger, Fritz, and Mayrhofer, 2003:266-267).

(11) a. Multos annos Gallia **sub imperio Romano** fuit. (locative)
many years Gaul under rule.ABL Roman.ABL be.PRET
'For many years Gaul was under Roman rule.'

b. **Sub imperium Romanum** Gallia cecidit. (directional)
under rule.ACC Roman.ACC Gaul fall.PRET
'Gaul fell under the Roman rule.'

(12) a. Alex tanzte **in dem Zimmer**. (German; Zwarts, 2006)
Alex dance.PST in the.DAT room
'Alex danced in the room.'

b. Alex tanzte **in das Zimmer**.
Alex dance.PST in the.ACC room
'Alex danced into the room.'

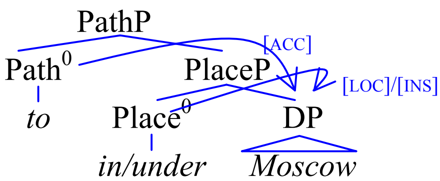
(13) a. Marina sprjatala knigu **pod stolom**. (Russian)
Marina hid book under table.INS
'Marina hid the book (somewhere) under the desk.'

b. Marina sprjatala knigu **pod** **stol**.
Marina hid book under table.ACC
'Marina hid the book under the (surface of the) desk.'

(14) a. Marina sprjatala knigu **v** **stole**. (Russian)
Marina hid book in table.LOC
'Marina hid the book (somewhere) in the desk.'

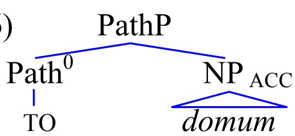
b. Marina sprjatala knigu **v** **stol**.
Marina hid book in table.ACC
'Marina hid the book in the desk.'

On the assumption that both Place^0 and Path^0 assign case,[5] it becomes necessary to accept multiple case assignment to the same goal (15) and to address the question of how this multiple case assignment ends up realized as accusative.

(15)


Several proposals are on the market to answer this question. One technical option is that the case assigned by Path^0 (accusative) overrides that assigned by Place^0. A similar proposal has been advanced by Pesetsky (2013): he argues that the underlying case of a noun in Russian is genitive (corresponding to N^0), which is overridden by the nominative assigned by D^0, which in turn can be overridden by the accusative assigned by v^0 or by other cases. Caha (2007, 2010) suggests that the DP is raised, shedding case layers – in the current context, it would be first to [Spec, PlaceP] and then to [Spec, PathP]. A third alternative is that the two cases are combined and the resulting set of case features is spelled out as accusative. This mechanism has been suggested by Matushansky (2008, 2010, 2012), who uses it to account for multiple case assignment to predicates. Yet a fourth option is that by Svenonius (2003), who proposes that the case assigned to the Ground is assigned by the complex p^0+P^0 head. Béjar and Massam (1999), Merchant (2006), Richards (2007), and Brattico (2011) also consider other instances of case-stacking and ways of accounting for it, demonstrating that some mechanism for dealing with multiple case-assignment is independently required.

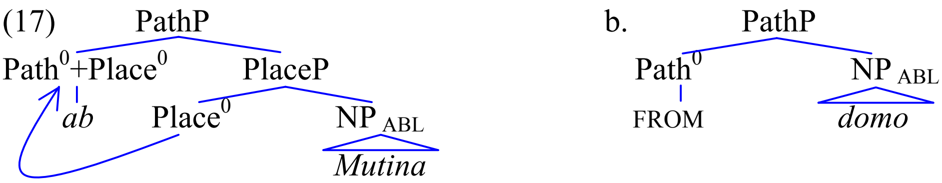
Whatever the mechanism adopted, it can also be used for the accusative used as allative with L-nouns: assuming that Path^0 in (10) is responsible for accusative case-marking in the PP in (11b), it is natural to extend the same explanation to (16), where case-assignment by Path^0 would be accusative in precisely the same way.

(16)


[5] Arsenijević and Gehrke (2008) propose that accusative is assigned by the verb. An obvious problem with this view are NP-internal directional PPs, such as *doroga v London*$_{ACC}$ 'a road to London'.

The ablative PathP is more complicated, since there is no locative/directional syncretism here: in ablative PPs there is always an overt preposition (*ab*, *ex*), whereas ablative L-nouns are just marked with ablative case, suggesting that the ablative Path^0 is null. To resolve this issue I suggest that the overt preposition results from Place-to-Path movement:

(17)



Summarizing, I have proposed that the bare allative and ablative L-nouns can be explained by the mechanism independently needed to account for case assignment in allative and ablative PPs: the null Path^0 responsible for the assignment of the relevant directional case (accusative and ablative, respectively).

This leaves us with two more facts to account for: the source of the locative case on L-nouns and an explanation of what happens when L-nouns appear with overt prepositions, as in (7).

4. The source of the locative case

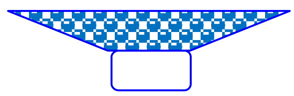
The assumption that locative PPs denote in the spatial domain accounts for the semantics of locative Ps and their internal composition, but not for their external syntax. As is easy to see, locative PPs can function as modifiers of entities (NP-internally) or events (VP-internally). For the former case at least, direct composition is impossible and the denotation of a locative PP must shift from a locus (however defined) to a set of entities (type ⟨e, t⟩). The existence of such a shift can then be used to account for the latter case as well:

(18) a. a house in New York
b. to live/walk in New York

As shown by Zwarts and Winter (2000), in order for a locative PP to be usable as a location for other entities, it needs to change from a spatial denotation into the more standard property interpretation. The function EIGEN$^-$ thus turns a locus-denoting PP into a predicate (type ⟨e, t⟩) – the set of entities located at this locus:

(19) $\text{EIGEN}^- =_{\text{def}} \lambda l \,.\, \lambda x \,.\, \text{EIGEN}(x) \subseteq l$

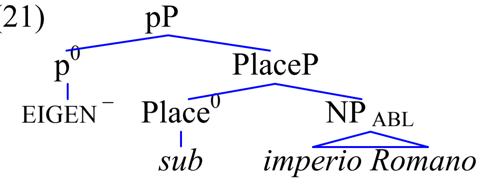
EIGEN$^-$ (*above* (EIGEN (⟦the TV⟧)))



Unlike EIGEN, EIGEN$^-$ cannot be hypothesized to be a lexical part of spatial prepositions, since spatial PPs can be augmented by directional prepositions and modified:

(20) a. [**from** [under the bed]
b. [[**six feet**] [behind the house]]

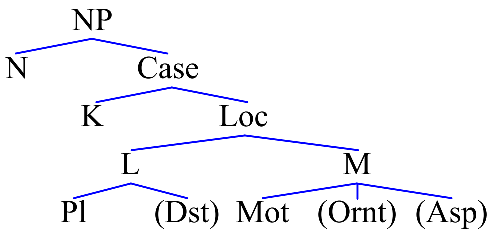
Because the measure phrase and the directional preposition need access to the spatial representation, they clearly do not combine with something of the type ⟨e, t⟩, which means that transition to the predicate type happens at a higher level than where the measure phrase and the directional preposition are merged. One reasonable assumption is then that EIGEN^{-} is a functional head: the p^0 of Svenonius (2003) (cf. Kratzer, 1996 for v°):

(21)


Adopting once again the assumption that the case assigned to the Ground in a PP results from the combination of features assigned by two heads (here, by p^0 and $Place^0$), we can now explain both the locative case of L-nouns and the fact that in the locative/directional case alternation, more than one surface case can be used, as illustrated in (13)-(14) for Russian.

Given that a specific $Place^0$ can determine the features it assigns, the combination p^0+$Place^0$ could also assign different cases in function of the choice of a $Place^0$. Conversely, in case of the combination $Path^0$+$Place^0$ the specific preposition in $Place^0$ may be unimportant, since the surface accusative is a reflection of the presence of a $Path^0$.

The hypothesis that a stative locative involves a decomposition p^0+$Place^0$, where p^0 encodes the independently needed EIGEN^{-} type-shift but does not contribute a true change in meaning makes it possible to reconcile the $Path^0$+$Place^0$ approach to directionals adopted here with the apparently radically different decomposition in Mel'čuk (1994), Kracht (2002) and Radkevich (2010). These authors argue for distinguishing *configuration* and *mode* components for both locative and directional cases (and PPs), as in [Mode [Loc DP]]. The *static* Mode yields simple locatives, all others are dynamic.[6] Radkevich (2010) argues for a yet more complex morphological picture in locative case encoding, suggesting the features Distal, Motion, Orientation and Aspect:

(22) (Radkevich, 2010)


What is crucial in all these approaches is that locative and directional PPs or cases are equally syntactically complex, whereas in the $Path^0$+$Place^0$ approach directionals contain locatives.

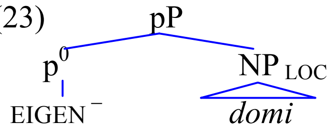
The hypothesis that locative PPs contain a pP layer introducing the independently necessary EIGEN^{-} type-shift reconciles the two positions: while directional PPs are semantically more complex, consisting of a PathP and a PlaceP, they do not comprise the totality of locative tree because directionals, which are not modifiers of either events or objects, do not include the

[6] Kracht's dynamic modes are the *co-final* (the object moves into the configuration during event time), the *co-initial* (the object moves from the configuration during event time), the *transitory* (the object moves in and out of the configuration during event time) and the *approximative* (the object approaches the configuration during event time). Mel'čuk codes the first three modes as, respectively, *prolative*, *elative* and *perlative*, and adds the *recessive* mode (the reverse of the approximative) and the *terminative* mode (movement up to the location). Kracht's *static* mode corresponds to Mel'čuk's *essive*, reflecting the standard locative case labels.

pP. The static mode, which would otherwise be semantically empty in Kracht's, Mel'čuk's and Radkevich's approach, now introduces the non-vacuous EIGEN^{-} type-shift.

Given that L-nouns, in our view, denote in the spatial domain, just like locative PPs, they also need the pP layer with the EIGEN^{-} type-shift in order to compose with the rest of the structure. For them as well, then, it is p^0 that is the source of the locative case:

(23)



Summarizing, we have accounted for the restrictions on the use of the locative case in Latin with a combination of two independently needed hypotheses: there exist nouns and noun phrases that denote in the spatial domain (L-nouns) and the case that they surface with (i.e., locative) is assigned by the functional head p^0 with the semantics of the EIGEN^{-} type-shift.

However, an obvious problem with the solution proposed above are cases like (7), where an L-noun combines with a preposition, but also like (24), where an L-noun functions as an argument. On the assumption that L-nouns denote loci, how can they be used in contexts requiring objects?

(Gildersleeve and Lodge, 1876:260)

(24) duobus annis postquam **Roma** condita est
two years after.that Rome.NOM founded is
'two years after Rome was founded'

To account for such cases it is necessary to pass from a locus to the unique object occupying that locus. Given the existence of EIGEN^{-} we only need a maximization operation akin to the regular definite article: EIGEN^{+} returns the maximal object occupying the relevant region:

(25) **EIGEN**$^{+}$: maps a locus to the unique entity located at this locus
$\lambda l \,.\, \iota x \,.\, \text{EIGEN}(x) = l$

EIGEN^{+} converts the locus *Rome* to the object constituting that locus, which can then function as a complement to a preposition or appear in an argument position.

5. The bigger picture

The hypothesis that some nouns can denote in the spatial domain explains multiple puzzles in a number of languages that do not restrict their locatives in precisely the same ways. To begin with some examples similar to the Latin pattern above, in Russian, the true locative case is only available for demonstratives, simplex wh-words and their existential derivatives, the universal quantifier, as well as the noun *dom* 'home':[7]

[7] What I have been glossing as LOC in traditional Russian grammar is called "the prepositional case". Its variant, the so-called *locative II*, is restricted to location-denoting nouns of the second (consonantal) declension and only to prepositions that are cognitively default for each particular noun. This phenomenon is therefore very much different from the focus of this paper, but see Haspelmath (2018).

(26) a. *gde* 'where', *kudá* '[to] where', *otkúda* 'wherefrom'
b. *zdes'*/*tut* 'here', sjudá '[to] here', *otjúda* 'from here'
c. *tam* 'there', tudá '[to] there', ottúda 'from there'
d. *vezdé*, *vsjúdu* '[to] everywhere', *otovsjúdu* 'from everywhere'

(27) *dóma* 'at home', *domój* 'homeward'

The locative preposition *te* in Modern Dutch is used only in highly formal register with city names and with the noun *huis* 'home' (Broekhuis, 2013:88, minor variation exists):

(28) a. Jan vestigt zich te Amsterdam. (Broekhuis, 2013:88)
Jan settles REFL in Amsterdam
'Jan is settling in Amsterdam.'

b. *Jan vestigt zich te Frankrijk/ deze stadt.
Jan settles REFL in France this city

The suffix ה was productive in Biblical Hebrew as the directional/locative case marker (Hoftijzer, 1981; Waltke and O'Connor, 1990; Arnold and Choi, 2003; Medill, 2013), but in Modern Hebrew this suffix is purely allative and limited to a handful of location-denoting nouns and place names (e.g., *arc.a* 'to the home country', i.e., 'to Israel', *yemin.a* 'to the right', *kadim.a* 'forward', etc., Zewi, 2013):[8]

(Zewi, 2013)
(29) ka-aseret alafim iš higiu le-latrun be-darkam yerušalaym.a
like-ten thousands person arrived to-Latrun in-way.POSS3PL Jerusalem.DIR
'About ten thousand people arrived at Latrun on their way to Jerusalem.'

It turns out that locative cases frequently have restricted distribution and that this restriction follows only four cross-linguistically attested patterns:[9]

(i) locative case restricted to L-nouns (Latin; Russian and English L-pronominals as discussed above; the Modern Hebrew directional ה; Maltese: Borg, 1987-1988; Itzaj Maya: Hofling, 2000:219)[10]

(ii) the reverse of the above: locative case-marking optional or absent for L-nouns (Biblical Hebrew: Waltke and O'Connor, 1990; Gurr-goni: Green, 1995:35; Tswana: Creissels, 2009; Western Armenian: Guekguezian, 2011; Yimas: Foley, 1991:165, 170-171)

[8] Examples like (29) show that restricted locatives can be used NP-internally; same evidence can be drawn from Russian (*doroga domoj* 'a road home').
[9] It is not the case that locative case is always restricted: in Turkish for instance, no restrictions are reported. We also set aside the fact that in a number of languages animate nouns cannot combine with locative cases (see, e.g., Anderson, 2003:355 on Basque, more examples are provided by Haspelmath, 2018).
[10] French would also appear to fit into this category with its locative clitics in addition to the usual repertoire of L-demonstratives and L-pronominals, but see also Matushansky (2015) for the hypothesis that proper names of countries in French are L-nouns.

(iii) special locative case forms for L-nouns (Hungarian (a handful of toponyms and a few common nouns): Rounds, 2001:118; Agul, Archi, Avar and Lezgian: Daniel and Ganenkov, 2009; Basque: de Rijk, 2007:57)

(iv) the case paradigm for L-nouns restricted to locative cases and genitive (Bagvalal: Daniel and Ganenkov, 2009; Diyari: Austin, 2013:53)

The hypothesis that L-nouns can denote locations (and paths) can explain these patterns. For the Latin case in (i), I proposed that only L-nouns denote loci. For the reverse scenario in (ii), I assume the same, but hypothesize that the locative case-marking in these languages is not the reflection of the syntactic environment (i.e., it is not assigned by p^0) but either instantiates EIGEN itself or indicates the presence of a null preposition that instantiates EIGEN and assigns it. In other words, L-nouns are locus-denoting in both in (i) and (ii), it is the locative marking that has different functions in the two types of languages. The third type of languages (iii) represent a mix of the properties of the preceding two: only L-nouns denote loci, as in both (i) and (ii), and have it marked with special morphology due to p^0, as in (i). For all others the default locative case is the same as in (ii): it is assigned by a null preposition that instantiates EIGEN.

Finally, to understand what is going on in the languages in (iv), it is necessary to recall that locus-denoting nouns cannot be used in argument positions and the EIGEN^+ type-shift was required to pass from a locus to the corresponding object. The crucial property of languages in the class (iv) is then the unavailability of EIGEN^+: either as a type-shifting mechanism or as a syntactic node. To obtain the corresponding object a sortal is required, combining with the locus-denoting toponym in the genitive case, as in Bagvalal:[11]

(Daniel and Ganenkov, 2009)

(30)	di-č’	k’ʷan-ł	han	raq’ʷa-łi	ek’ʷa.
	I.OBL-CONT	Kvanada-GEN	village.NOM	heart-INTER	COP

‘I remember Kvanada. *(lit.* The village of Kvanada is in my heart*)*’

The structure exemplified in (30) seems to be the historical source of the appositive genitive (*the city of New York*).

To summarize, it is the basic lexical dichotomy between locus-denoting and object-denoting nouns that is responsible for the patterns in (i) through (iv). In function of what locative cases stand for in a given language (a marker of locus denotation vs. the functional head encoding EIGEN) and whether the shift from a locus denotation to the corresponding object is available the four patterns above are obtained. Importantly, it is the formal domain distinction as opposed to the simple intuition that there are places and there are things (Mackenzie, 1992; Haspelmath, 2018) that makes possible for me to explain the distribution of L-nouns.

[11] Daniel (1999) indicates that this constraint is not in force for all and any place names: e.g., *mosku* ‘Moscow’ in the unmarked citation form can be used both as nominative or as essive (*in Moscow*), and individual variation is rife.

6. Conclusion and further questions

An examination of the Latin locative case and the corresponding directional uses of ablative and accusative argues for adopting locus denotations for some proper names and common nouns (L-nouns). As the dedicated spatial domain is required at any rate to account for the meaning of locative prepositions, it is unsurprising that there should be nominals that denote in that domain.

To explain how bare directional L-nouns work, I have appealed to the independently needed hypothesis that directional PPs contain a PathP layer on top of a locative (PlaceP) denotation. As a result of this assumption, the bare directional accusative and bare ablative NPs can be treated as a PathP on top of an L-noun and the cases can be argued to be assigned by the appropriate Path^0.

The need for a type-shifting p^0 layer on top of locative PlacePs that would enable a locative PlaceP to function as a VP- or NP-modifier can then explain locative case-marking on bare L-nouns: the same p^0 is needed to pass from a spatial denotation to a set denotation enabling further composition. In addition to this functional head with the semantics of EIGEN$^-$, another type-shifter, EIGEN$^+$, is necessary to account for the fact that in most languages loci naturally have entity-correlates.
As a result of these independently motivated assumptions, we can account for a set of cross-linguistic generalizations about restrictions on the use of locative case. More specifically, I proposed the following three points of variation:

- whether a language has locus-denoting nouns at all
- whether each given locative case (form) indicates the presence of more structure (when corresponding to a hidden preposition) or less (when corresponding to the default case-marking on lexical loci resulting from the presence of p^0)
- whether coercion to object-denotation is available

Among potential extensions of this line of research I consider the hypothesis (Matushansky, 2016) that French core locative prepositions *à* 'at/to' and *de* 'from' should be treated as locative case markers on L-nouns, which would make it possible to account for the famous *en/au* alternation (Cornulier, 1972; Zwicky, 1987; Miller, Pullum, and Zwicky, 1997) in the terms of case, explaining the sensitivity of this alternation to locative semantics, gender and phonology. Another case of interest is temporal bare nominals (e.g., *Monday*, *next week*; cf. also Bresnan and Grimshaw, 1978; McCawley, 1988), which not only fall into the same lexical-semantic class, but also provide some insights into how loci should be encoded. Once this is done, the question arises whether other instances of nominal locatives (e.g., unmarked definite locatives in Modern Greek (Ioannidou and Dikken, 2009; Terzi, 2010; Gehrke and Lekakou, 2012), Rapa Nui (Kieviet, 2017), French (Stolz, Lestrade, and Stolz, 2014) or Western Armenian) can be explained along the same lines and what the connection might be to the fact that so many weak definites (e.g., *to school*, *downhill*, see Stvan, 1998, 2007; Carlson and Sussman, 2005; Aguilar-Guevara and Zwarts, 2013, 2010; Aguilar-Guevara, 2014; etc.) are locative (for a functionalist explanation in the terms of differential marking see Haspelmath, 2018).

Finally, the proposed treatment of directional bare L-nouns and multiple case-assignment and multiple case-marking in the directional/locative case alternations supports a decompositional

Jakobsonian approach to syntactic and morphological case in the terms of complexes of case features assigned by the functional heads in the immediate environment (Matushansky, 2008, 2010, 2012).

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Multiple accent in alternative questions[1]

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Abstract. Alternative Questions (AltQs) are typically characterized by two prosodic cues: a final falling boundary tone and a pitch accent on each disjunct. Recent accounts in the literature have taken the final fall as the central surface cue for AltQ interpretation or have assigned a vacuous semantic contribution to the multiple accent on the disjuncts. Based on data from English and Turkish, we argue that both cues are equally important and require modelling in a unified account of AltQs. Combining ingredients from the literature (Roberts, 1996; Biezma, 2009; Westera, 2017), we propose that, essentially, the multiple accent shapes the Question under Discussion (QUD) and that the final fall, or the lack thereof, indicates restrictions on the content of the QUD via (un)satisfaction of Attention Maxims.

Keywords: Alternative Questions, prosody, discourse, focus, Q-particles, Turkish.

1. Introduction

It has long been known that the interpretation of a disjunctive question relies on its prosodic structure (Bartels, 1999):

(1) a. Do you want coffee$_{\text{L*H-}}$ or tea$_{\text{H*L-L\%}}$?
Which one of the following do you want: coffee or tea? [AltQ]
b. Do you want coffee or tea$_{\text{L*H-H\%}}$?
Is it true that you want coffee or tea? [PolQ]

The Alternative Question (AltQ) interpretation, as in (1a), is associated with (i) an obligatory pitch accent on each disjunct (henceforth: multiple accent) and (ii) a final falling boundary tone. For the Polar Question (PolQ) interpretation in (1b), on the other hand, the multiple accent is not obligatory and the boundary tone is usually a rise (Bartels, 1999; Biezma and Rawlins, 2012; Han and Romero, 2004; Roelofsen and van Gool, 2010).[2]

Although the intonational realization of AltQs has been extensively discussed in the literature (Bartels, 1999; Schubiger, 1958), the meaning contribution of each intonational cue is still unclear. Though early approaches looked at the multiple accents (e.g., Han and Romero (2004)), current approaches reveal a bias towards the final fall. This bias is reflected both at the empirical and at the theoretical level. Firstly, experimental work has been taken to show that the crucial ingredient for the AltQ interpretation is the final fall (Pruitt and Roelofsen, 2013). Secondly, prominent theoretical accounts have only modelled the final fall as an ingredient of

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[2]The obligatoriness of the multiple accent in AltQs is the result of there being multiple intermediate phrases, one per disjunct (Bartels, 1999), since every intermediate phrase needs (at least) one pitch accent (Beckman and Pierrehumbert, 1986). PolQs consists of one single intermediate phrase including all disjuncts (Bartels, 1999) and, thus, a multiple accent is possible but not obligatory. Intermediate phrase boundaries are marked by - in the ToBi annotation system. Throughout the paper, ↑ indicates a rising pitch accent plus intermediate phrase boundary L*H- or , when used sentence final, the rising boundary tone L*H-H%; ↓ indicates the falling boundary tone H*L-L%.

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AltQ interpretation (Biezma and Rawlins, 2012) or have taken the semantic contribution of the multiple accent to be vacuous (Roelofsen and van Gool, 2010).

The aim of this paper is to show that the multiple accent comes with a meaning contribution that is as integral a part of the AltQ interpretation as the final falling boundary tone is and, thus, it needs to be modelled. We will put forward two arguments: one on PolQ and AltQs in English and one on AltQs in Turkish. Based on these two arguments, and combining ideas in Roberts (1996), Biezma (2009) and Westera (2017), we will propose that the function of the multiple accent is, ultimately, to *shape the QUD* (Question under Discussion), while the function of the boundary tones is to further *restrict the content of the QUD*.

A disclaimer is in order at this point. It is beyond the aim of this paper to offer a full compositional analysis of the at-issue content and presupposition of AltQs. Unlike wh-questions, AltQs are known to presuppose that at least one (minimality) and at most one (exclusivity) of the alternatives in the Hamblin set is true (Belnap and Steel, 1976; Karttunen, 1977). However, several issues in the current literature need to be addressed before arriving at a proper compositional derivation of these effects.[3] The aim of the present paper is simply to vindicate the importance of the multiple accent in AltQ interpretation and assign it an active role, which can later be combined with other ingredients in a full compositional derivation.

The structure of the paper is as follows. In section 2, we review two recent accounts by Biezma and Rawlins (2012) and Roelofsen and van Gool (2010) and a prominent experimental paper by Roelofsen and van Gool (2010). In section 3, we firstly put forward some exemplary data from English showing that the final fall cannot be the only ingredient for AltQ composition; secondly, we discuss data from Turkish, in which the multiple pitch accent that we observe for English is mirrored with a Q-particle (Kamali, 2015) and which cannot be explained by previous accounts. Section 4 presents the proposal. We conclude in section 5.

2. Background

2.1. Biezma and Rawlins (2012)

Biezma and Rawlins (2012) argue that the crucial difference between AltQs and (run-off-the-mill) PolQs lies in the presence vs. absence of a closure operator, signalled by the final fall: AltQs come with a final fall and the corresponding closure operator while (run-off-the-mill) PolQs do not. The main idea, due to Zimmermann (2000), is that a falling contour in English signals closure in list constructions in general, i.e., it indicates that nothing but the listed items has the property at hand, as in (2B); a rising contour, instead, signals lack of closure, i.e., it suggests that objects other than the listed items have the relevant property, as in (2B'):

(2) A: Which tube stations are one stop from Oxford Circus?
B: Piccadilly Circus, Bond Street, Tottenham Court Road, Green Park, Regents Park↓.
B': Piccadilly Circus, Bond Street, Tottenham Court Road, Green Park, Regents Park↑

Biezma and Rawlins (2012) point out that AltQs and PolQs provide a parallel contrast: While the AltQ in (3) with a final fall indicates that only the listed alternatives are part of the current

[3]One issue concerns the exact size of the disjuncts: whether *or* in e.g. (1a) connects two NPs (von Stechow, 1991), two proposition-denoting constituents (Han and Romero, 2004) or two polar questions (Pruitt and Roelofsen, 2011; Uegaki, 2015). A second issue is the relation between *or* and interrogativity: whether the disjunctive phrase in AltQs has the semantics of a wh-phrase or of a declarative disjunctive phrase.

QUD –and thus answer (3B) is infelicitous–, the PolQ in (4) with a final rise allows for other alternatives to be part of the current QUD –thus making the answer (4B) acceptable.

(3) A: What are you cooking for tomorrow's party? Are you cooking pasta↑ or stew↓?
B: # I'm making risotto, I think.

(4) A: What are you cooking for tomorrow's party? Are you cooking pasta↑?
B: I'm making risotto, I think.

Biezma and Rawlins (2012) implement this idea by making the final fall / closure operator on a question $[_{[Q]}\alpha]$ introduce the presupposition that the set of alternatives generated by $[_{[Q]}\alpha]$ equals the set of salient alternatives in a given context, i.e., the QUD of that context, as defined in (5). Accommodating this presupposition amounts to inferring what the questioner assumes the complete QUD is. For AltQs, since a final fall is produced, alternatives other than the ones mentioned are eliminated from the QUD, as in (6). For PolQs, unmentioned alternatives are allowed in the QUD, as in (7):

(5) **Closure operator** (Biezma and Rawlins, 2012)
$[\![[[_{[Q]}\alpha]_{H*L-L\%}]]\!]^c =_{\text{def}} [\![[_{[Q]}\alpha]]\!]^c$, defined only if SalientAlts(c) = $_{\text{def}}[\![[_{[Q]}\alpha]]\!]^c$.

(6) QUD / SalientAlts(c) for (3):
{you are making pasta, you are making stew, ~~you are making risotto, ...~~ }

(7) QUD / SalientAlts(c) for (4):
{you are making pasta, you are making stew, you are making risotto, ...}

In sum, Biezma and Rawlins (2012) connect closure to the final fall. They do not model the multiple accent as an ingredient of AltQ composition.

2.2. Roelofsen and van Gool (2010)

Roelofsen and van Gool (2010) model the difference between AltQs and PolQs in the framework of Inquisitive Semantics, in which they distinguish three semantic layers: the set of possibilities $[\![.]\!]_P$, the set of highlighted possibilities $[\![.]\!]_H$, and the set of possible updates $[\![.]\!]_S$. In their account, disjunction introduces alternatives. For the examples (8)-(9) below, this means that, at the level of the IP α, we have the set of possibilities {Ann plays the piano, Bill plays the piano}. The set of possibilities of the entire question, $[\![\text{Q } \alpha]\!]_P$, consists of the possibilities of α itself and the possibilities that α excludes, both for PolQs and AltQs, as in (8a)-(9a). The first difference between PolQs and AltQs comes in $[\![.]\!]_H$, which is affected by the presence of a single vs. multiple accent. Roelofsen and van Gool (2010) propose that accents indicate focus and, in computing the $[\![.]\!]_H$ of a given constituent with focus, all the original alternatives of that constituent collapse, i.e., are merged via $\cup$. For PolQs, which only have mandatory accent on the second disjunct introducing a single focus on the entire disjunct, this means the original set {Ann plays the piano, Bill plays the piano} collapses into { Ann plays the piano $\vee$ Bill plays the piano}, as in (8b). For AltQs, since we have one focus per disjunct, the original singleton set of alternatives arising from the first disjunct, namely {Ann plays the piano}, vacuously collapses into {Ann plays the piano}, and similarly for the second disjunct. This leads to (9b). Hence, the netto effect of multiple accent is simply to leave the original set of alternatives untouched. Finally, $[\![.]\!]_S$ is affected by the final fall which, in their account, signals the presence of an exclusive strengthening operator, resulting in (8c) and (9c):

(8) Does [Ann or Bill]$_F$ play the piano ↑?

a. $[\![(8)]\!]_P = \{\text{a play, b play}\} \bigcup \{\neg\ \text{play(a)}, \wedge\neg\ \text{play(b)}\}$

b. $[\![(8)]\!]_H = \{\text{a play} \vee \text{b play}\ \}$

c. $[\![(8)]\!]_S = \{\text{a play} \vee \text{b play}\ \}$

(9) Does [Ann]$_F$ or [Bill]$_F$ play the piano ↓ ?

a. $[\![(9)]\!]_P = \{\text{a play, b play}\} \bigcup \{\neg\ \text{play(a)}, \wedge\neg\ \text{play(b)}\}$

b. $[\![(9)]\!]_H = \{\text{a play, b play}\}$

c. $[\![(9)]\!]_S = \{\text{a play} \wedge\neg\text{play(b)}, \neg\text{play(a)} \wedge \text{b play}\}$

Thus, Roelofsen and van Gool (2010) model the multiple accent as making each of two singleton sets vacuously collapse, with the result that its netto semantic contribution is null.

2.3. Pruitt and Roelofsen (2013)

The results of an experimental study by Pruitt and Roelofsen (2013) suggest that the final fall is the crucial ingredient for AltQ composition. Their experiment served to investigate the role of the intonation contour (number of accents and final rise or fall) on the interpretation of an disjunctive question as AltQ or PolQ. They conducted a perception experiment with the following four conditions: Multiple Accent+Final Fall, Single Accent+Final Rise, Single Accent+Final Fall, Multiple Accent+Final Rise. Two of the conditions were original productions by a female native speaker of American English, namely, Multiple Accent+Final Fall (original AltQ) and Single Accent+Final Rise (original PolQ). The other two, Multiple Accent+Final Rise and Single Accent+Final Fall, were resynthesized as a result of splicing the initial part of one original recording with the final contour of the other recording in Praat (Boersma and Weenink, 2018). See Fig. 1.

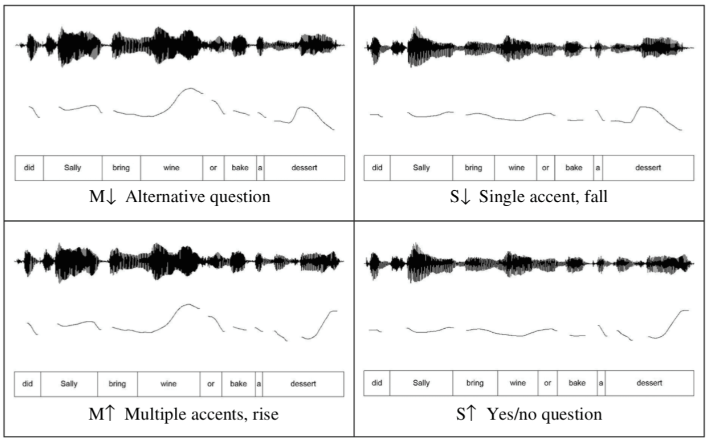

Figure 1: Exemplar intonation contours of one question in each of the four conditions used in the experiment. Upper left and lower right panels show original recordings, and upper right and lower left panels show the spliced versions, respectively (from Pruitt and Roelofsen (2013): 639).

Participants were presented with the auditory stimuli in all four conditions and had to choose the best paraphrase from the provided choices for each question on an answer sheet, as in (10):

(10) Did Sally bring wine or bake a dessert [4 conditions]. (Pruitt and Roelofsen, 2013)
  a. Which of these things did Sally do: bring wine or bake a dessert? [AltQ]
  b. Did Sally do any of these things: bring wine or bake a dessert? [PolQ]
  c. Other:...

For the two conditions based on original recordings (Multiple Accent+Final Fall, Single Accent+Final Rise), Pruitt and Roelofsen (2013) found that participants chose the expected paraphrases: interrogatives with a multiple accent and a final fall were predominantly interpreted as AltQs, whereas recordings with a single accent and a final rise most often led to the perception of a PolQ, as shown in Fig. 2.

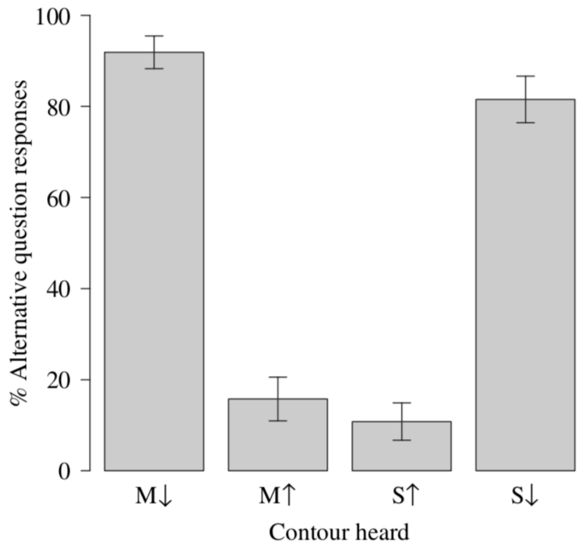

Figure 2: Proportion of alternative question responses for each presented contour, whiskers represent 95% confidence interval (from Pruitt and Roelofsen (2013): 642).

In the spliced condition based on the first part of an AltQ and the final contour of a PolQ (Multiple Accent+Final Rise), participants predominantly chose the PolQ paraphrase. The second spliced condition, resynthesized from the first part of a PolQ and the final contour of an AltQ (Single Accent+Final Fall), was more often interpreted as an AltQ. In other words, participants tend to judge a question with no multiple accent but with a final fall as an AltQ, based on which the authors concluded that the final fall is the crucial ingredient for AltQ composition.

2.4. Interim Summary

In this section, we reviewed two prominent theoretical accounts and one experimental study, showing that the consensus in both the theoretical and empirical literature is that the final fall is the most important ingredient for AltQ composition. Prominent theoretical accounts either do not model the multiple accent (Biezma and Rawlins, 2012) or take its netto semantic contribution to be null (Roelofsen and van Gool, 2010). Experimental work suggests that the final fall is the crucial cue for interpreting a disjunctive question as an AltQ (Pruitt and Roelofsen, 2013).

In the remainder of this paper, we will argue that the multiple accent should be modelled with a non-null semantic contribution in a unified account of AltQs in English and Turkish.

3. The Multiple Accent

This section serves to present two arguments in favour of an analysis of AltQs in which there is a clear division of labour between the final fall and the multiple accent, and thus against analyses that take the final fall as the crucial cue. The first argument concerns falling questions in English and the second argument concerns AltQs in Turkish.

3.1. Revisiting Falling Questions in English

It has long been known that PolQs[4] can be produced with a fall from any high nuclear tone (H*) to a L-L% boundary tone (e.g., Bartels (1999)), as shown in (11) and Fig. 3 .

(11) Are you from New York ↓?

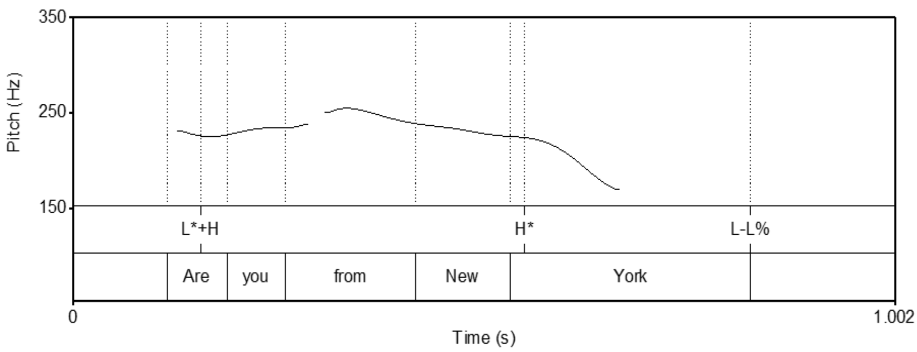

Figure 3: Pitch track of a falling PolQ by a native English speaker.

There is no reason why disjunctive PolQs should be different from non-disjunctive PolQs in this respect. Indeed, we can observe falling disjunctive PolQs, as in (12) and Fig. 4.

(12) Context: *You are teaching a class on popular culture and want to discuss a film. For the next discussion point, you need a student who has seen Kill Bill or Resevoir Dogs, no matter which one of them, To make sure this is the case, you ask every student before they start speaking:*
Did you see Kill Bill or Resevoir Dogs ↓ ?

Note that Pruitt and Roelofsen (2013) included a comparable intonation condition in their perception experiment (Multiple Accent+Final Fall) and participants predominantly interpreted questions with that intonation contour as an AltQ. The observation that falling disjunctive PolQs exist, however, automatically raises the question why the recordings in that condition

[4]We specifically refer to PolQs with interrogative syntax here. We do not consider rising declaratives or other types of PolQs.

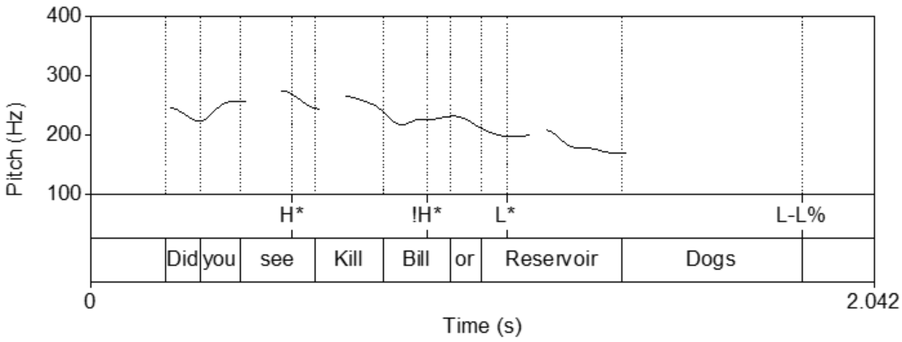

Figure 4: Pitch track of a falling disjunctive PolQ by a native English speaker.

were not interpreted as PolQs in their study. At this point, we consider two possible explanations for their experimental findings, as we will discuss in the following sections.

3.1.1. Acoustic properties

One possible reason why the participants in Pruitt and Roelofsen's (2013) experiment perceived and interpreted questions produced with no multiple accent and a final fall mostly as AltQs may lie in an acoustic difference between the exact shape of the final fall in AltQs vs. PolQs. Since Pruitt and Roelofsen (2013) used original recordings of falling AltQs and rising PolQs and digitally spliced the two recordings for the Multiple Accent+Final Fall condition, the final fall in this condition might be slightly different from the one English speakers would actually produce in a falling PolQ. One might hypothesize that a final fall alone does not trigger an AltQ interpretation, but that the interpretation is depending on the exact shape of the fall towards the low boundary tone. In some preliminary production data by a female native speaker of American English, we do see slight differences in the nuclear contour of falling PolQs and AltQs: in PolQs the nuclear accent tends to be a low tone (L*) combined with a L-L% boundary tone, whereas for the AltQ we do find a high nuclear accent (H*) and thus a steeper fall into the L-L% configuration. This can be seen if one compares the final nuclear accent (on *REsevoir dogs*) of Fig. 4 with the corresponding final part of Fig. 5.

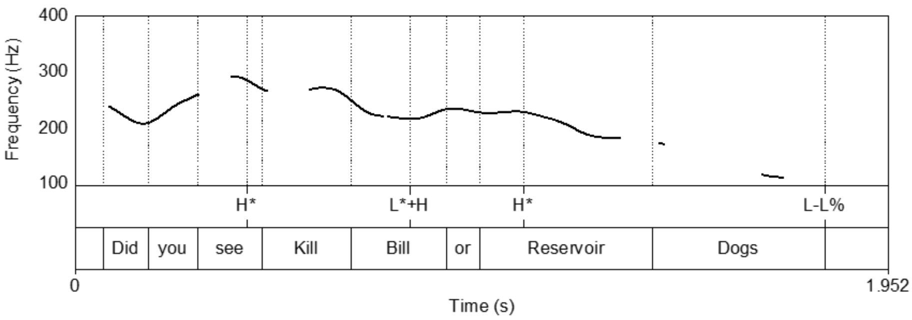

Figure 5: Pitch track on an AltQ by a native English speaker.

Testing this hypothesis, however, outreaches the scope of this paper. At this point, we use this observation as a pointer towards a possible alternative explanation of the results by Pruitt and Roelofsen (2013).

3.1.2. Pragmatic licensing

An alternative hypothetical explanation of the experimental results by Pruitt and Roelofsen (2013) is the fact that falling PolQs in general require very specific pragmatic licensing. Schubiger (1958) already observed that falling PolQs are more restricted than their rising counterparts, in that rising PolQs are the default and that falling ones require special pragmatic contexts without which they are infelicitous. Such contexts are, for instance, contexts in which the speaker is only interested in the proposition questioned, and not in any alternative proposition, as illustrated in (13) from Bartels (1999):

(13) a. *In a guessing game*
Is it green↓? Does it grow here↓?
b. *To spouse who is unpacking the suitcase*:
Did you find my camera↓? Did you leave it in Edinburgh↓?

In the experiment by Pruitt and Roelofsen (2013), the test items were presented in isolation, with no supportive context licensing the falling intonation. Hence, the likeliness that participants would get a falling PolQ interpretation decreased.

3.1.3. Embedded AltQs

In the previous two subsections, we presented two possible explanations for the findings by Pruitt and Roelofsen (2013). There is one additional relevant observation concerning the importance of the multiple accent in AltQs: When embedding within a declarative sentence, as in (14), both AltQs and PolQs are produced with a final fall, as can be seen in Fig. 6 and Fig. 7.

(14) John is wondering whether you saw Kill Bill or Resevoir Dogs ↓.

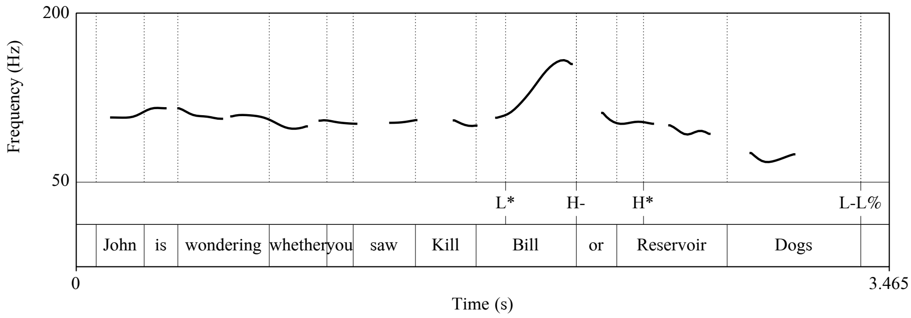

Figure 6: Pitch track of an embedded AltQ by a native English speaker.

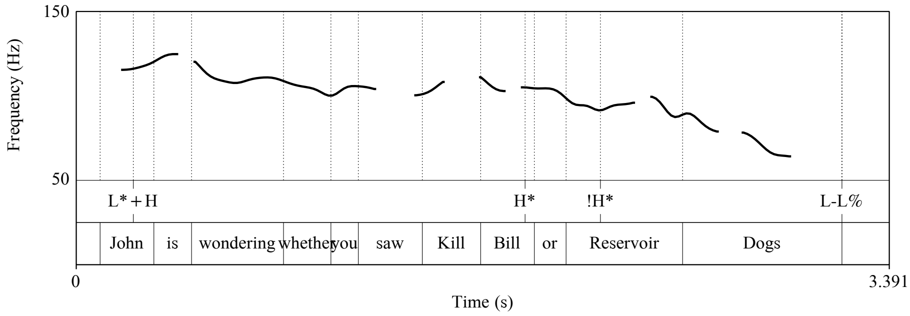

Figure 7: Pitch track of an embedded PolQ by a native English speaker.

Thus, the main cue distinguishing an AltQ from a PolQ in embedded position is not the final fall, but the obligatory multiple accent concomitant to the multiple intermediate phrases.[5] If the final fall is the most important ingredient for AltQ composition, this observation requires an additional explanation.

Altogether, this section has shown so far that PolQs and AltQs are not distinguished by the final fall alone, based on two data points. First, (matrix) PolQs can have a final fall as well. The fact that Pruitt and Roelofsen (2013) did not find the corresponding PolQ interpretation in their experiment can be potentially explained by the acoustic difference between the PolQ fall and the AltQ fall or by the fact that falling PolQs are pragmatically restricted. Second, when embedded within a declarative clause, both AltQs and PolQs are produced with a final fall, the distinguishing cue being the accents.

3.2. Q-Particles in Alternative Questions in Turkish

In Turkish, the distribution of accents in AltQ and PolQ parallels that in English. Furthermore, the multiple accent is mirrored by occurrences of the Q-particle *mI* (Kamali, 2015). This is shown in (15): If an occurrence of the Q-particle accompanies each disjunct, we have an AltQ interpretation; PolQs, instead, are formed with one single occurrence of the Q-particle (and, if disjunctive, with the disjunction form *veya* ‘or’):

(15) a. Ali iskambil **mi** (oynadi) yoksa futbol **mu** oynadi?
Ali cards Q play.past or$_{alt}$ football Q play.past
‘Did Ali play cards or football?’ [AltQ]

b. Ali iskambil veya futbol oynadi **mu**?
Ali cards or$_{decl/pol}$ football play.past **Q**?
‘Did Ali play cards or football’? [PolQ]

The composition of Turkish AltQs makes two important points. First, it shows that, crosslinguistically, multiple marking on the disjuncts is of great importance in AltQ composition. Without *mI* in each disjunct in (15a), the sentence cannot be interpreted as an AltQ.

Secondly, Turkish opens a window into the semantic contribution of the multiple marking on the disjuncts. It is known that *mI* also appears in PolQs, signaling that the constituent it attaches

[5]See footnote 2. Note that *Kill Bill* bears an accent with an intermediate phrase boundary in Fig. 6 and an accent without intermediate phrase boundary in Fig. 7.

to is focused (Kamali, 2015), as illustrated in (16).[6] Thus, the placement of the particle in PolQs has a direct semantic/pragmatic impact.

(16) a. Ali iskambil oynadi **mi**?
Ali cards play Q
'Did Ali play cards?' [neutral]
b. Al *mi* iskambil oynadi?
Ali Q cards play
'Was it Ali who played cards?' [focus on Subject]
c. Ali iskambil **mi** oynadi?
Ali cards Q play
'Was it cards what Ali played?' [focus on Direct Object]

Hence, *mI* makes a non-null contribution in PolQs. Assuming parsimoniously that *mI*'s contribution remains constant throughout the grammar, we conclude that *mI* has a non-null semantic contribution in AltQs as well.

3.3. Interim Summary

Altogether, in section 3, we have shown that an analysis of AltQs encompassing English and Turkish data should model the multiple accent, based on the observations that (a) AltQs and PolQs in English are not solely distinguished by whether the final contour is falling or rising and (b) that the multiple Q-particle in Turkish makes its own non-null semantic/pragmatic contribution.

4. Towards an Analysis

In this section, we aim at a unified analysis of the multiple accent/Q-particle that accounts for (i) the semantic effect of *mI* in Turkish PolQs, (ii) the mandatory status of the occurrence of the Q-particle *mI* in each disjunct in Turkish AltQs, and (iii) the mandatory status of the multiple accent in English AltQs. Key will be the (parsimonious) assumption that the contribution of the Turkish Q-particle *mI* is exactly the same in PolQs and AltQs. By extending Biezma's (2009) account of focal accent in English PolQs to *mI* in Turkish PolQs and exploiting the equation "*mI* in PolQs = *mI* in AltQ", we arrive at an analysis of multiple accent / Q-particle in AltQs.[7]

4.1. Ingredients from the literature

To this end, we will use three ingredients, all available in the literature. The first ingredient is the hierarchical organization of discourse in terms of QUDs (Roberts, 1996; Büring, 2003). The second ingredient is Focus-marking (Rooth, 1992), which is realised by a focal accent in English and by the Q-particle *mI* in Turkish (Kamali, 2015). Biezma (2009) proposes that the position of Focus-marking in English PolQs determines the general shape of the QUD. We will extend this idea to Focus-marking signaled by the position of the Q-particle *mI* in Turkish PolQs. Our third and final ingredient is Westera's (2017) A(ttention) Maxims. Westera (2017)

[6]There are similar patterns in other languages, such as Sinhala (Slade, 2011) and Macedonian (Rudin et al., 1999; Jordanoska and Meertens, 2018).
[7]See Westera (2017: 284ff.) for a parallel extension of Biezma's (2009) acount of English PolQs to English AltQs based on the shape of the accents.

proposes that the satisfaction vs. unsatisfaction of A-Maxims is encoded via falling vs. rising boundary tones in English, which we will extend to AltQs in Turkish.

Let us introduce each of these ingredients in some more detail.

First, we follow Roberts (1996) and take discourse structure to include, among other things, a stack of (often implicit) QUDs. This produces, after a move m at a given point of discourse, a set of hierarchically ordered and yet-to-be-answered questions. The order is based on the contextual entailment relation $<$ relating questions q to subquestions q', as defined in (17)-(18). An example is provided in (19), where the question 'Who ate what?' has as subquestions 'What did Amy eat?' and 'What did Bob eat?', which in turn have their own subquestions:

(17) For all q and $q' \in$ QUD(m), if $q < q'$, then the complete answer to q' contextually entails a partial answer to q.

(18) A question q_1 contextually entails another q_2 iff answering q_1 in a discourse context with common ground C is such that $C \cup Ans(q_1)$ (i.e., the answer to q_1) entails a complete answer to q_2.

(19)

- Who ate what?
  - What did Amy eat?
    - Did Amy eat tofu?
    - Did Amy eat natto?
    - ...
  - What did Bob eat?
    - Did Bob eat tofu?
    - Did Bob eat natto?
    - ...

For our second ingredient, we follow Rooth's (1992) analysis of Focus and Biezma's (2009) idea to apply it to QUD structure. Besides its (ordinary) semantic value, an expression ϕ has a focus semantic value $[\![\phi]\!]^f$ built from substituting the denotation of the Focus-marked element(s) within ϕ with alternative denotations of the same semantic type. An example is given in (20a), where the subscript F indicates Focus-marking. This $[\![.]\!]^f$ is used to constrain the value of certain free variables C via the focus felicity condition of the squiggle operator $\sim$, defined in (20b):

(20) a. $[\![$ Ali$_F$ played cards $]\!]^f$ = {a played cards, b played cards, c played cards, ...}
b. $[\![\phi \sim$ C $]\!]$ is felicitous only if $[\![$C$]\!] \subseteq [\![\phi]\!]^f$

In our case, and following Biezma (2009), the location of Focus-marking will be used to constrain the general shape of the immediately higher question in the QUD stack. For example, the same string *Did Ali play cards?* will function as subquestion of different questions depending on what element bears Focus-marking: If the focus is on the subject, the immediately higher question will be 'Who played cards?', as in (21); if the focus is on the direct object, the immediately higher question will be 'What did Ali play?', as in (22); and so on:

(21) QUD: Who played cards?

Did ALI$_F$ play cards? Did BESte$_F$ play cards? ...

(22) QUD: What did Ali play?

Did Ali play CARDS$_F$? Did Ali play FOOTball$_F$? ...

The third and final ingredient is Westera's (2017) A-Maxims. Parallel to Grice's (1975) Information Maxims governing the delivery of information, Westera (2017) defines A(ttention)-Maxims governing attentional intents, that is, governing the set of possibilities or states of affairs that the speaker may draw the audience's attention to. For our analysis, we will use the Maxims of A-Quality and of A-Relation in (24), parallel to the traditional Information Maxims in (23):

(23) Grice's (1975) (Information) Maxims:
  a. Quality: Assert only information that you consider true.
  b. Relation: Assert only information that you consider relevant.

(24) Westera's (2017) Attention Maxims:
  a. A-Quality: Intend to draw attention only to states of affairs that you consider epistemically possible.
  b. A-Relation: Intend to draw attention only to states of affairs that you consider relevant.

Westera (2017) proposes that the speakers attitude towards the A-Maxims is reflected in the boundary tones. When an utterance ends in a final fall, it signals that the speaker believes that all A-Maxims are satisfied, that is, that there are no relevant epistemically live possibilities other than the ones that the speaker has drawn attention to in the sentence. The final rise, on the other hand, signals that the speaker considers the possibility that not all A-Maxims are satisfied.

Let us examine this distinction closer with an example:

(25) a. Are you from New York↑?
  b. Are you from New York↓?

The form with a final rise in (25a) signals that the speaker considers the possibility that there are relevant epistemically live alternatives other than the addressee being from New York, for example the addressee being from Los Angeles or from Boston. Hence, a speaker would use this form e.g. if what she is after is where the addressee is from and, even though she is right now asking about New York, she wants to signal to the addressee that she is interested in any other epistemically live possibility as well (so that, if the addressee is not from New York, he can volunteer the information of where he is from). In contrast, the question with a final fall in (25b) signals that the speaker believes that the only relevant epistemically live possibility is whether or not the addressee is from New York. This would be appropriate, for example, if the speaker is checking whether the addressee complies with the prerequisite of being for New York to qualify for some insurance or contract (where being from Los Angeles or being from Boston would not help and, thus, constitute live but *ir*relevant possibilities); or it could be used in a quiz show where the rules dictate that the speaker can only posit PolQs and the addressee can only answer with bare 'yes' and 'no', hence making the other epistemically live possibilities *ir*relevant (since the addressee is not allowed to volunteer any further information beyond 'yes' and 'no').

Importantly, the relationship between rise vs. fall and the speakers obedience of the A-Maxims can be applied to sub-sentential constituents as well, as illustrated in (26):

(26) Barbara visited Loulou↑, Sophie↑, and Mila↓ for Christmas.

In this case, the rises signal that the speaker, till that point, still considers other relevant live possibilities to be available. The concluding fall signals that the speaker is finished listing what she thinks are the relevant live possibilities in the context (cf. Biezma and Rawlins, 2012).

4.2. Combining the ingredients

We propose (i) that *mI* in Turkish and focal accent in a question *Q* have the same semantic contribution, namely F-marking, (ii) that the free variable *C* refers to the immediate superquestion of *Q* in the QUD structure, and (iii) that the value of this *C* is shaped by the squiggle operator $\sim$ –which we propose attaches to the IP node of *Q*– à la Biezma (2009) and is restricted via the un/satisfaction of A-Maxims indicated by boundary tones à la Westera (2017).

In the following, we will illustrate how this works for different PolQ forms and for AltQs in English and Turkish.

Our first group of question forms is **PolQs with broad focus**, that is, PolQs where the entire IP is Focus-marked. As we saw in section 3.1, English PolQs can be pronounced with a final rise, as in (27), or with a final fall, as in (30) below. (27) with a **final rise** is analysed in (28). The $\sim$-operator is attached under the Q-morpheme at LF, as in (28a). This determines, via the focus felicity condition (20b) and following Biezma (2009), the general shape of the value of C, that is, of our immediately higher QUD. The result is (28b), by which our ⟦C⟧/QUD is required to be a subset of the set {a(li) played cards, b(este) danced, s(eda) sang,...} containing alternative values to the Focus-marked IP. Finally, following Westera (2017), the final rise signals that our ⟦C⟧/QUD may contain (relevant epistemically live) possibilities other than the one expressed by the original IP, thus imposing no further restrictions on ⟦C⟧/QUD, as in (28c). The end result is that sentence (27) with broad focus and with a final rise is understood as being a sub-question of the QUD 'What happened?', where 'what' ranges over several IP values, producing the QUD structure in (29):

(27) Did [Ali play cards]$_F$ ↑?

(28) a. LF: [Q [$_{IP}$Ali play cards]$_F$ $\sim$C]
b. ⟦C⟧ / QUD $\subseteq$ ⟦[Ali played cards]$_F$⟧^{f} = {a played cards, b danced, s sang,...}
c. ⟦C⟧ / QUD = {a played cards, b danced, s sang,...}
= 'What$_{\{\text{a played cards, b danced, s sang,...}\}}$ happened?'

(29) What$_{\{\text{a played cards, b danced, s sang,...}\}}$ happened?

Did a(li) play cards? Did b(este) dance? Did s(eda) sing? ...

Example (30), with the same broad focus but with a **final fall**, is analysed in (31). Steps (31a) and (31b) are exactly the same as steps (28a) and (28b). The only difference comes in step (31c): Since the speaker used a final fall, she indicates that there are no (relevant epistemically live) possibilities in the immediately higher QUD other that the one expressed by the original IP. Formulating the QUD again as a wh-question, the end result is that sentence (30) with broad focus and with a final fall is understood as being a sub-question of the QUD 'What happened?' where 'what' ranges only over the possilibity 'ali played cards', as represented in the QUD structure (32):

(30) Did [Ali play cards]$_F$ $\downarrow$?

(31) a. LF: [Q[$_{IP}$Ali play cards]$_F$ $\sim$C]
b. $[\![$C$]\!]$ / QUD $\subseteq$ $[\![$[Ali played cards]$_F]\!]^f$ = {a played cards, b danced, s sang,...}
c. $[\![$C$]\!]$ / QUD = {a played cards, ~~b danced, s sang,...~~}
= 'What$_{\{\text{a played cards}\}}$ happened?'

(32) What$_{\{\text{a played cards}\}}$ happened?
|
Did a(li) play cards?

PolQs with broad focus in **Turkish** are formed by placing the particle *mI* at the end of the sentence, as in (39). Steps (a) and (b) in the analysis are the same and in the cases (28) and (31) above. However, when it comes to the intonation contour, we have found only a final fall reported in the literature.

See Fig. 8. Thus, we do not presently know whether and, if so, how Westera's (2017) distinction between satisfaction vs. unsatisfaction of A-maxims is encoded in Turkish PolQs. For the time being, we tentatively conclude that (39) might be mandatorily interpreted as in (28), mandatorily interpreted as in (31), or optionally interpreted as either of the two options.

(33) [Ali iskambil oynadi]$_F$ **mi**?
[Ali cards play]$_F$ Q?
'Did Ali play cards?' (=(16a))

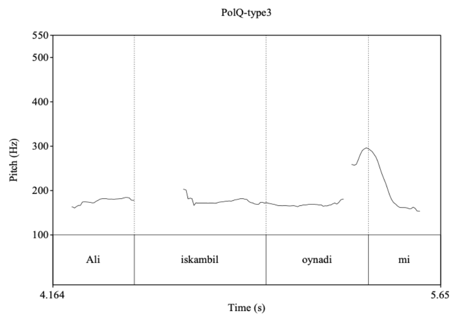

Figure 8: Turkish PolQ with broad focus.

Our second group of question forms are **PolQs with narrow focus**, which for the sake of illustration we will place on the subject. First, we will tackle the form with a **final rise**, exemplified in (34). Now only the subject *Ali* is Focus-marked, as indicated in the LF (35a), which means that $[\![$Ali$_F$ played cards $]\!]^f$, and thus our $[\![$C$]\!]$/QUD, consists of propositions that share the same VP property and differ solely in the value of subject, as shown in (35b). Given that the final boundary tone is a rise, no further constraints are imposed on our $[\![C]\!]$/QUD, leading to (35c). The result is that (34) with narrow focus on the subject and a final rise is understood as a sub-question of the QUQ 'Who (out of ali, beste, seda,...) played cards?', as shown in the QUD structure (36):

(34) Did $[\text{Ali}]_{\text{F}}$ play cards ↑?

(35) a. LF: $[\text{Q}[_{IP}\text{Ali}_{\text{F}}$ play cards$] \sim \text{C}]$
b. $[\![C]\!]$ / QUD $\subseteq$ $[\![\text{Ali}_F$ played cards $]\!]^f$ = {a play cards, b play cards, s play cards,...}
c. $[\![C]\!]$ / QUD = {a played cards, b played cards, s played cards,...}
= 'Who$_{\{\text{a,b,s,...}\}}$ played cards?

(36) Who$_{\{\text{a,b,s,...}\}}$ played cards?

Did a(li) play cards? Did b(este) play cards? Did s(eda) play cards? ...

If, instead of a rise, the PolQ with narrow focus was pronounced with a **final fall**, as in (37), steps (a) and (b) in the analysis would be the same. The only difference, again, would come in step (37c): Given that the speaker used a fall, the QUD is further constrained as to include only the expressed alternative 'ali played cards', since the speaker has signalled that there is no other relevant epistemically live alternative. Hence, sentence (37) is understood as a sub-question of the QUD 'Who (of out ali) played cards?', as represented in the tree (38):

(37) a. LF: $[\text{Q}\ [_{IP}\ \text{Ali}_{\text{F}}$ play cards$] \sim \text{C}]$
b. $[\![C]\!]$ / QUD $\subseteq$ $[\![\text{Ali}_F$ played cards $]\!]^f$ = {a play cards, b play cards, s play cards,...}
c. $[\![C]\!]$ / QUD = {a played cards, b played cards, s played cards,...}
= 'Who$_{\{\text{a}\}}$ played cards?

(38) Who$_{\{\text{a}\}}$ played cards

Did a(li) play cards?

PolQs with narrow focus in **Turkish** are formed by placing *mI* right after the constituent intended to be in focus, as illustrated in (39). The derivation is parallel up to the steps (a) and (b) that we just saw. However, again we have only found a final fall for these questions forms, shown in Fig. 9. We leave open what step (c) looks like for narrow focus PolQs in Turkish. Nevertheless, let us note that Karatas (2017) discusses a use of the question form (39) as 'surprise' question: The speaker hears the news that Seda, Beste, Ali and others played cards last night, she is surprised to hear this about Ali and then asks (39). For this use, an analysis along the lines of (37c)/(38) would be appropriate, since the only (epistemically live) possibility that the speaker

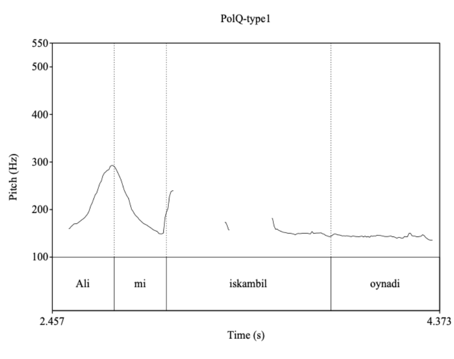

Figure 9: Turkish PolQ with narrow focus.

cares about at the time of the utterance is that of *Ali* having played cards.

(39) Al *mi* iskambil oynadi?
Ali Q cards play
'Was it Ali who played cards?' (=(16b))

We come to our third group of question forms. What happens if, instead of Focus-marking on the simple subject Ali_F, we have Focus-marking on the disjunctive subject $[Ali\ or\ Beste]_F$, as in (40)? That is, how are **PolQs with (a single) narrow focus over an entire disjunctive phrase** analysed? No matter whether they are produced with a final rise or fall, the only difference with respect to the analysis of the second group is that the focus alternatives of the subject are of type e for simple Ali_F but of generalized quantifier type <<e,t>,t> for $[Ali\ or\ Beste]_F$, which allows for more complex alternative denotations like 'curt or david', 'seda and patrick', etc. In the case of a final rise in (40), the derivation procedes as in (41) and leads to the QUD tree (42):

(40) Did $[\text{Ali or Beste}]_{\text{F}}$ play cards ↑?

(41) a. LF: $[\text{Q}[_{IP}[\text{Ali or Beste}]_{\text{F}} \text{ play cards}] \sim \text{C}]$
b. $[\![\text{C}]\!]$ / QUD $\subseteq$ $[\![[\text{Ali or Beste}]_{\text{F}} \text{ played cards }]\!]^f$ =
$\{$a or b played cards, c or d played cards, s and p played cards,...$\}$
c. $[\![\text{C}]\!]$ / QUD = $\{$a or b played cards, c or d played cards, s and p played cards,...$\}$
= 'Who$_{\{[\text{a or b}],[\text{c or d}],[\text{s and p}],...\}}$ played cards?

(42) Who$_{\{[\text{a or b}],[\text{c or d}],[\text{s and p}],...\}}$ played cards?

Did a or b play cards? Did c or d play cards? Did s and p play cards? ...

In the case of a final fall in (43), the derivation procedes as in (44) and results in the QUD structure (45):

(43) Did $[\text{Ali or Beste}]_{\text{F}}$ play cards ↓?

(44) a. LF: $[\text{Q}[_{IP}[\text{Ali or Beste}]_{\text{F}} \text{ play cards}] \sim \text{C}]$
b. $[\![\text{C}]\!]$ / QUD $\subseteq$ $[\![[\text{Ali or Beste}]_{\text{F}} \text{ played cards }]\!]^f$ =
$\{$a or b played cards, c or d played cards, s and p played cards,...$\}$
c. $[\![\text{C}]\!]$ / QUD = $\{$a or b played cards, ~~c or d played cards, s and p played cards,...~~$\}$
= 'Who$_{\{[\text{a or b}]\}}$ played cards?

(45) Who$_{\{[\text{a or b}]\}}$ played cards
|
Did a(li) or b(este) play cards?

We come to our fourth and final group of question forms: **AltQs** in English and Turkish, illustrated in (46)-(47):

(46) Did $[\text{Ali}]_{\text{F}}$↑ or $[\text{Seda}]_{\text{F}}$↓ play cards?

(47) [Ali] mi↑ yoksa [Seda] mi↓ iskambil oynadi
Ali Q or$_{\text{alt}}$ Seda cards play.PAST cards
'Which of the two, Ali or Seda, played cards?'

Two aspects of the this question form are crucial for the analysis. First, each disjunct receives its own focal accent in English and its own *mI*-marking in Turkish, resulting in multiple accent and multiple *mI*-marking. This will be modelled as having two F-markings at LF, one per disjunct. We assume without argument that the disjunction involves partially elided propositional disjuncts –e.g., the disjunction of two IPs– (Han and Romero (2004), Erschler (2018), a.o.) and attach a $\sim$-operator at the top of each disjunct, as in (48a). This means that each Focus-marking and associated $\sim$-operator will contribute separately to the shaping of $[\![C]\!]$/QUD, as sketched in (48b). Second, the boundary tone on the first disjunct is a rise and the boundary tone on the final disjunct is a fall, both in English (Bartels, 1999) and Turkish (see Fig. 10).

In terms of Westera's (2017) A-maxims, boundary tones at sub-sentential constituents are analysed as in (26) above: the rise on *Ali* indicates that there are relevant epistemically live alternatives other than the ones mentioned up to this point, while the fall on *Seda* signals that there are no further relevant epistemically live alternatives at this latter point. This leads to the further pruning in (48c). The result is that the AltQ (46)/(47) is understood as a sub-question of the QUD 'Who (out of ali and seda) played cards?', as represented in the QUD structure (49):

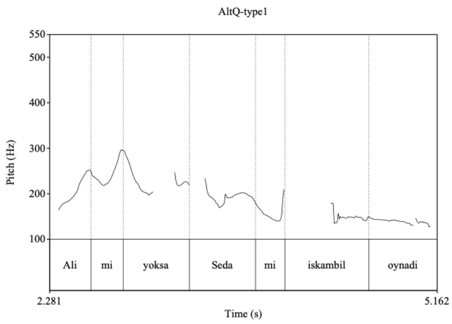

Figure 10: Turkish AltQ.

(48) a. LF: [[Q[$_{IP1}$ Ali$_F$ play cards] $\sim$ C] or [$_{IP2}$ Seda$_F$ play cards] $\sim$ C]]
b. $[\![C]\!] \subseteq [\![\text{IP1}]\!]^f = [\![\text{IP2}]\!]^f$ = {a played cards, s played cards, c played cards,...}
c. $[\![C]\!]$ = QUD = {a played cards, s played cards, ~~c played cards,...~~}
='Who$_{\{a,s\}}$ played cards?

(49) Who$_{\{a,b\}}$ played cards?
|
Did Ali$_F$↑ or Seda$_F$↓ play cards?

5. Conclusion

We have shown that both the final fall and the multiple accent contribute to AltQ interpretation and need to be modelled in a unified analysis of English and Turkish AltQs. Extending Biezma (2009) on focus accent in PolQs to multiple accent in AltQs, we proposed that the contribution of the multiple accent is to shape the QUD via focus marking, and, following Westera (2017), that the final fall restricts the content of the QUD via (un)satisfaction of the A-Maxims.

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Embedded Epistemic Modals Pragmatically[1]

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Abstract. In Slovenian there is an attitude verb, *dopuščati* ('allow for the possibility'), which is like an existential dual of *believe*. My goal is to explain why it cannot embed epistemic modalities with universal force, like *must* or *cannot*. I will say that it is because of a competition and equivalence with the corresponding belief sentence. I will revise the contribution of epistemic modals and use blind scalar implicatures to achieve this.

Keywords: epistemic modal, embedding, existential belief, exhaustification.

1. Introduction

There is an asymmetry in embedding epistemic modals under attitudes of different strengths:[2]

(1) Situation: John sees people come in with wet umbrellas. You report:

a. Janez misli, da {utegne, mora} iti dež. $B\Diamond r$, $B\Box r$
John thinks that might must go rain
'John thinks that it {might, must} be raining.'

b. Janez dopušča, da {utegne, *mora} iti dež. $D\Diamond r, {}^*D\Box r$
John allows that might must go rain
'John allows for the possibility that it {might, must} be raining.'

c. Janez {misli, *dopušča}, da ne more biti sončno. $B\neg\Diamond\neg r, {}^*D\neg\Diamond\neg r$
John thinks allows that not can be sunny
'John {thinks, allows} that it can't be sunny.'

A strong attitude verb like *think* embeds epistemic modal verbs across the board (Stephenson, 2007), while a weak one like *dopuščati* clashes with an embedded universal (epistemic) force: in (1b) with *mora* and in (1c) with *ne more*. Intuitively, these combinations are odd because *dopuščati* is too weak for the choice of epistemic force in the embedded clause.

In this paper I draw a parallel (§4) between the oddness of embedded universal epistemic force above and the oddness of certain sentences involving scalar implicatures, e.g. **Some Italians come from a warm country* (Magri, 2009, 2011)). In order to be able to adopt the mechanism proposed for the latter cases, I will reconsider what epistemic modals (qua evidence-sensitive items) contribute pragmatically. Building on Mandelkern (2019) and Močnik (2019), I will take (§3) epistemic modals to be sensitive to the body of evidence supplied by the attitude verb in two ways: evidence is not unlearned – the epistemic modal base quantifies over subsets of the doxastic state (see Mandelkern (2019)), and evidence is not always partially examined –

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[2]I use * in a theory-neutral sense: it marks unacceptability without making the claim that the observed effect is due to ungrammaticality. Question marks (??, ?) are used to signal lesser degrees of unacceptability.

there is a possible world from which the epistemic modal base and the doxastic state coincide. Section §2 provides a brief overview of the relevant properties of *dopuščati* and embedded epistemic modals (see Močnik (2019) for more details).

2. Patterns of embedding epistemic modals

Following the recent interest in the contribution of embedded epistemic modals (a.o. Stephenson (2007), Hacquard (2006), Yalcin (2007)), Anand and Hacquard (2013) investigate the landscape of epistemic-embedding attitudes (see also Crnič (2014) and Ippolito (2017)). They observe for Romance that doxastic verbs like *fear*, *hope*, or *doubt* (analysed as existential) do not embed modals like *must*.

Slovenian provides an additional data point with *dopuščati*, which does not encode a bias that one could exploit in order to understand why some epistemic embeddings are odd.[3] It simply expresses that something is consistent with the attitude holder's belief state; it lacks the discursive properties of verbs like *concede*, *accept* or *allow* (for the sake of the argument). As illustrated below, *dopuščati* contributes weak quantification, (2), and it can be reinforced into a belief claim, (3).

(2) Situation: John is either inside the house or outside the house. The speaker is asked whether they know where John is.
Dopuščam, da je notri, dopuščam pa tudi, da je zunaj. $Dp \wedge D\neg p$
I.allow that is inside I.allow though also that is outside
'I allow for the possibility that he's inside but I also allow for the possibility that he's outside.'

(3) Seveda, dopuščam, da je Zemlja okrogla – trdno verjamem, da je. $Dp \wedge Bp$
of.course I.allow that is Earth round firmly I.believe that is
'Of course I allow for the possibility that the Earth is round – I firmly believe that it is.'

Thus, the oddness in (1b) is puzzling because the sentence ($D\Box p$) seems to express simply that 'it is consistent with John's beliefs that it is raining in all of the worlds compatible with his (and possibly other's) evidence.' There is nothing inconsistent or inherently conflicting about this thought.

The generalization seems to be that oddness can arise only when the flavour of the embedded modal is epistemic (and not, e.g., deontic) and when the modal is understood to be anchored to the attitude holder, rather than some other body of evidence (e.g. by an 'according to' in the embedded clause). I will limit my study to the anchored cases mentioned in (1).

2.1. Negated attitude verbs

Anand and Hacquard (2013: fn. 27) find that main clause negation makes the embedding of a necessity modal under a doxastic attitude degraded. Here is my example (judgments vary

[3] Anand and Hacquard (2013) use a diversity presupposition, which needs p as well as non-p worlds to be in the doxastic set. This would lead to problems with our (3). Ippolito (2017), on the other hand, has an account where duality between epistemic modals is not maintained, which is problematic in light of (1c). Her account, however, comes closest in the literature to the view we need for this data.

somewhat between speakers, so I will mark the most charitable interpretation, e.g. '??' should be read as '?? or worse').

(4) Situation: You, me, and John see Bob go home from work early. We sit down on some couches in front of Bob's office. John has his back turned to Bob's door. He puts on some headphones and starts cheating on the latest homework. After a while, Bob, who has a secret entry to his office, which he used to come back, creeps out of his office and comes up behind John's back. John, still immersed in cheating, does not notice this. I nudge you and whisper, with both of us staring at Bob:

a. John does not think that Bob might be behind his back. $\neg B\Diamond p$

b. ??John does not think that Bob must be behind his back. $??\neg B\Box p$

c. It's not the case that John thinks that Bob must be behind his back. $\neg B\Box p$

d. Janez ne misli, da je Bob mogoče za njegovim hrbtom.
John not thinks that is Bob maybe behind his back
'John does not think that Bob might be behind his back.' $\neg B\Diamond p$

e. ??Janez ne misli, da mora biti Bob za njegovim hrbtom.
John not thinks that must be Bob behind his back
'John does not think that Bob must be behind his back.' $??\neg B\Box p$

f. Janez ne dopušča, da je Bob mogoče za njegovim hrbtom.
John not allows that is Bob maybe behind his back
'John does not allow that Bob might be behind his back.' $\neg D\Diamond p$

g. ??Janez ne dopušča, da mora biti Bob za njegovim hrbtom.
John not allows that must be Bob behind his back
'John does not allow that Bob must be behind his back.' $??\neg D\Box p$

Given (4b)/(4e) and (4g), necessity modals seem to be dispreferred under either force.[4] This is in line with the observations in Anand and Hacquard (2013), Homer (2015: ex. (106)), Crnič (2014: ex. (62)), and Ippolito (2017: fn. 9). Interestingly, while oddness is observed above with *misliti*, which does not seem to be a neg-raiser, the effect is absent under *it's not the case that* in (4c). The account I provide has some space for this kind of flexibility.

Further work is needed to investigate the exact conditions under which an embedded necessity modal is odd. Kai von Fintel (p.c.), for example, points out that the context in (4) does not give John any reason for entertaining the thought that Bob must be behind his back, which is why (4b) might be odd. In (5), however, where this has been changed, speakers still resist *must*.[5]

(5) Context: You and I have had the opportunity to work as assistants to Sherlock Holmes, who is investigating a recent murder. Sherlock has taken an interest in the gardener and the butler. You and I are discussing what Sherlock thinks about who the murderer is.

?*Sherlock does not think that the gardener must be innocent (since he followed him around this morning).*

[4] While I did not systematically check this with all the native speakers, *have to* is similarly odd in (4b) and (5) to the ones that I did ask.

[5] Some speakers feel that (5) is as bad as (4b). The difference observed with the others might be related to the fact that *because/since* can suspend implicatures, e.g. *Some students passed the exam because all of them did*.

3. Analysing what epistemic modals express

I will build on earlier work in Močnik (2019), which offers a compositional account of the ideas explored in this section (I refer the reader to that work for certain details).

Recall that what we want to capture is the observation that embedded universal epistemic force is odd under *dopuščati* and negated doxastic attitudes. To do this, we will use two constraints on epistemic modal bases, taking them to be a reflect of how speakers reason with evidence.

The first constraint, **Locality**, is formulated in Mandelkern (2019). He proposes that epistemic modals are inherently local, i.e. the modal base is restricted to the information state it is evaluated against, such as the belief state in (6).

(6) $\forall w' \in \mathscr{B}_a^w : MB(w') \subseteq \mathscr{B}_a^w$ (adapted from Mandelkern (2019))
(for all of the worlds w' in the agent a's belief worlds in w: the worlds compatible with the agent's evidence in w' are part of the agent's doxastic state at w)

I propose to interpret Mandelkern's constraint as follows. Suppose that our individual beliefs (p, q, ...) serve as pieces of evidence, which we use to navigate the world. For example, if I believe that it is raining, the proposition 'it is raining' can serve as evidence for John being at home. When an epistemic modal is embedded under a belief predicate, the modal is restricted by this body of established evidence (the attitude holder's beliefs).

Notice that Locality allows the modal base to form a proper subset of the doxastic state. A way to think about this is that people can also consider whatever they are not sure of, so propositions that are merely consistent with their beliefs. For example, I might act in accordance with the proposition *The weather report is accurate* even if I do not fully trust weather reports. As it turns out, it was a good thing to bring an umbrella. On the other hand, it does not seem rational for me do the same with propositions that blatantly contradict my beliefs, such as the horoscope being correct.

Is this just a mere restatement of having various degrees of credence in a proposition? It seems to be more than that if we think of evidence as something that we can *still* learn. Locality can be conceptualized as a rationality constraint against unlearning: we do not "unlearn" evidence (i.e. give up what constitutes the information state), but we can learn it. Thus, we can check whether the prejacent would be true if we learned more evidence than what we currently have.

This brings us to the second constraint, **Totality**. The intuition behind it is that agents do not work only under the assumption that they will always learn more. It is rational to also consider the evidence as is, in its totality. In terms of the previous analogy, this is a constraint against performing only hypothetical learning updates.

(7) $\exists w' \in f(\mathscr{B}_a^w) : \mathscr{B}_a^w = MB(w')$
(there is a world w' in the chosen part of a's doxastic state at w, such that the worlds compatible with the agent's evidence in w' coincide with his doxastic state)

This constraint uses a function f over the belief state that picks out the salient part of it, if there is one. The main purpose of this is to avoid the Binding Problem (Karttunen and Peters, 1979):

we need to ensure that the existential contribution of *dopuščati* and the existential contribution of Totality talk about the same world. See Močnik (2019) for an alternative.

To see what the two constraints yield, consider Figure 1.

(a) $D_J \Box_i p$ happens to be true here (b) $D_J \Diamond_i p$ true, $B_J \Diamond_i p$ false

Figure 1: Some situations

The modal base function i (part of the object language) maps w_1 onto the doxastic state, i.e. $\{w_1, w_2\}$, and it maps w_2 onto itself, i.e. $\{w_2\}$. Thus, at both worlds the agent (John) does not unlearn the established evidence (the modal base function remains within the doxastic set). This satisfies Locality. At w_2 it happens to be the case that the agent learns more, which is permitted. Totality can also be satisfied since the evidence considered from w_1 coincides with the established evidence, i.e. the modal base function maps w_1 onto the doxastic state.

It helps to examine Figure 1a to see that embedded universal modal force creates a very strong statement. In particular, it makes $D_J \Box_i p$ as strong as $B_J \Box_i p$. Totality ensures that there is a chosen world, such as the one on the left, at which the agent's beliefs and evidence coincide. This same world (via f) is such that the prejacent p is true in all the worlds (the $\Box_i p$ part) compatible with the agent's evidence from it. Notice that this means then that the prejacent p is true throughout the agent's belief state.[6] By contrast, the interplay of Totality and Locality makes a difference for embedded existential force: $D_J \Diamond_i p$ is strictly weaker than $B_J \Diamond_i p$, as shown in Figure 1b.

I will not go through the cases of negated attitudes, but choosing f in a way that is analogous to the system proposed in Močnik (2019) yields Figure 2 below.

$$\begin{tikzcd}
& & B_J \Box_i p \arrow[dl] \arrow[dd, leftrightarrow] \\
D_J \Diamond_i p & B_J \Diamond_i p \arrow[l] & \\
& & {}^{*}D_J \Box_i p \arrow[ul]
\end{tikzcd}$$

$$\begin{tikzcd}
{}^{*}\neg D_J \Box_i p \arrow[dd, leftrightarrow] & & \\
& \neg B_J \Diamond_i p \arrow[ul] \arrow[dl] & \neg D_J \Diamond_i p \arrow[l] \\
{}^{(*)}\neg B_J \Box_i p & &
\end{tikzcd}$$

Figure 2: Contextual entailments, oddness annotated

[6]Notice that if instead of $\Box_i p$ we had $\neg \Diamond_i p$, we would still be looking at a universal statement, but about $\neg p$. See Močnik (2019) for a spell-out of this in terms of the truth-conditions.

The goal of §4 is to explain the distribution of stars (oddnesses) in Figure 2, where arrows represent contextual entailments among sentences, abbreviated schematically. The bracketed star on $\neg B_J \Box_i p$ marks the fact observed in (4) that oddness is sensitive to how negation is spelled out.

4. Deriving oddnesses using blind scalar implicatures

The main idea of this section is that the source of oddness in sentences with embedded epistemic modals is the same as that observed in sentences like (8), where blind scalar implicatures are said to trigger a contextual contradiction.

(8) **Some Italians come from a warm country.* (Magri, 2009, 2011)

4.1. Blind scalar implicatures

The sentence in (8) intuitively strikes us as odd because it conveys that not all Italians are from Italy. This intuition is captured by the reasoning, going back to Hawkins (1991), that (8) triggers the scalar implicature *Not all Italians come from a warm country*, which clashes with our world knowledge. Magri (2009, 2011) uses a system of blind exhaustification that creates this inference and makes it obligatory.

LFs contain at every scope site a silent exhaustivity operator (like a covert *only*) that combines with a free variable $\mathscr{R}$ and a prejacent, as in Figure 3. The free variable ranges over the scalar[7] alternatives that are contextually relevant for the prejacent. In particular, the prejacent itself is postulated to be relevant (uncancellable) as well as anything contextually equivalent to it. In Figure 3, for example, the denotation of $\mathscr{R}$ will contain the prejacent (*Some Italians...*) and the alternative *All Italians...*, since they entail each other contextually in this case.

The exhaustivity operator said to be blind (=not see) the contents of free variables, such as $\mathscr{R}$. It only looks at all the scalar alternatives and negates (excludes[8]) the ones that it consistently can. Crucially, thus, the notion of consistency that the operator uses is not contextual but semantic – it is blind to pragmatic information such as Italians being people that come from Italy. So as far as the operator is concerned, so to speak, it is consistent to "say" *Some Italians come from a warm country and not all Italians do*.

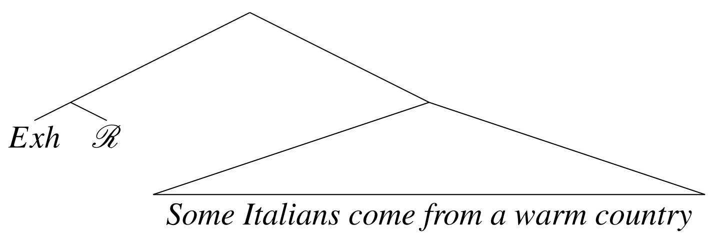

Figure 3: LF of (8), drawn with only the matrix exhaust

[7] 'The set $Alt(\varphi)$ of *scalar alternatives* of the prejacent LF φ consists of those LFs that can be obtained from the target LF φ by replacing one or more scalar items in φ with their Horn-mates.' (Magri, 2011: p. 7)

[8] 'The set $Excl(\varphi)$ of alternatives *excludable* w.r.t. the prejacent φ consists of those scalar alternatives $\psi \in Alt(\varphi)$ such that ψ can be negated *consistently* with φ.' (Magri, 2011: p. 8)

The way this works more concretely is in (9). The set $Excl(\varphi)$ contains the set of excludable alternatives, i.e. scalar alternatives of φ that can be (semantically) consistently negated with φ. Note, for example, that φ is not an excludable alternative to itself, so even though it is relevant, it will never be negated. In practice, it will be up to $\mathscr{R}$ to have the final say in which semantically-consistent-with-φ scalar-to-φ alternatives are negated. For example, when only the prejacent is relevant, the effect of the exhaustivity operator is not visible.

(9) $Exh_{\mathscr{R}}(\varphi) = \varphi \wedge \bigwedge_{\psi \in \mathscr{R} \cap Excl(\varphi)} \neg\psi$ (Magri, 2011: p. 9)

The background assumption is that when exhaustification produces something trivial (a contradiction or a tautology), this triviality is the source of oddness and unacceptability. We will use this strategy to explain why oddness arises with embedded epistemic modals.

4.2. Blindness with modals and attitudes

Some and *all* are (lexical) scalar alternatives (along with possibly other expressions, such as *most*). Let's assume the same kind of competition between epistemic modals and (separately) between doxastic attitudes (*dopuščati* and *misliti*). I will assume that the exhaustivity operator is sensitive (=not blind) to the requirement that restrictors of natural language quantifiers be non-empty. Thus, for example, $B_J\varphi$ entails $D_J\varphi$. By contrast, the exhaustivity operator is blind to Totality and Locality. Given that modals are context-sensitive expressions in that their flavour (e.g. epistemic) is determined contextually, any restrictions on epistemic modals bases should come in contextually as well. Finally, I will ignore any exhaustivity operators within the embedded clause (i.e. in the complement of the attitude verb) for the sake of simplicity.

Consider first 'John thinks it must be raining' ($B_J\Box_i p$) from (1a). The attitude verb and the modal are stronger than their respective scalar alternatives, so the combination yields the semantically strongest expression in the set of alternatives $\{D_J\Diamond_i p, B_J\Diamond_i p, D_J\Box_i p, B_J\Box_i p\}$. This means that the set of excludable alternatives is empty, see Figure 4, line 1, column 2. Hence, even though $D_J\Box_i p$ is contextually relevant (column 3), it is not excluded (column 4). The enriched meaning (last column) is then simply the prejacent. (The term 'minimal relevance' $\mathscr{R}_{min}$ refers to the relevance that is due to the equivalences in Figure 2.)

By contrast, 'John allows that it must be raining' ($D_J\Box_i p$) from (1b) is semantically weaker than $B_J\Box_i p$, so $B_J\Box_i p$ can be excluded and in fact must be because it is relevant (Figure 4, line 2, column 3). $B_J\Box_i p$ is minimally relevant for $D_J\Box_i p$ because the modal base function i pragmatically strengthens $D_J\Box_i p$ and makes it equivalent to $B_J\Box_i p$. This means that the enriched meaning (last column) is contextually contradictory.

φ	$Excl(\varphi)$	$\mathscr{R}_{\text{min}}(\varphi)$	$Excl(\varphi) \cap \mathscr{R}_{\text{min}}$	$Exh_{\mathscr{R}_{\text{min}}}(\varphi)$
$B\Box p$	$\{\}$	$\{D\Box p, B\Box p\}$	$\{\}$	$B\Box p$
$D\Box p$	$\{B\Diamond p, B\Box p\}$	$\{D\Box p, B\Box p\}$	$\{B\Box p\}$	$D\Box p \wedge \neg B\Box p \;\Leftrightarrow_c \perp$
$B\Diamond p$	$\{D\Box p, B\Box p\}$	$\{B\Diamond p\}$	$\{\}$	$B\Diamond p$
$D\Diamond p$	$\{B\Diamond p, D\Box p, B\Box p\}$	$\{D\Diamond p\}$	$\{\}$	$D\Diamond p$

Figure 4: Computing the minimally enriched meanings (last column), subscripts omitted

The result we obtain for (1b) in line 2 is thus parallel to Magri's **Some Italians come from a warm country*.

For the sentences with embedded existential force, while the minimally enriched meanings in lines 3 and 4 in Figure 4 are simply the prejacents, this need not be so. Consider the enriched meanings in (10), which convey that John is unopinionated with respect to p.

(10) a. $Exh_{\mathscr{R}_1}(B_J\Diamond_i p) = B_J\Diamond_i p \wedge \neg D_J\Box_i p \wedge \neg B_J\Box_i p$
b. $Exh_{\mathscr{R}_1}(D_J\Diamond_i p) = D_J\Diamond_i p \wedge \neg D_J\Box_i p \wedge \neg B_J\Box_i p$
c. $Exh_{\mathscr{R}_2}(D_J\Diamond_i p) = D_J\Diamond_i p \wedge \neg B_J\Diamond_i p$

Negated attitude verbs are more complex to analyse due to the embedded exhaustivity operator between the negation and the attitude verb. For example, 'John doesn't think that Bob might be behind his back' from (4d) has the LF: $Exh_{\mathscr{R}}(\neg Exh_{\mathscr{R}'}(B_J\Diamond_i p))$. This enriched meaning is analysed in Figure 5, line 3, where χ is the prejacent of the matrix exhaust and $\mathscr{R}'$ is replaced by a subscript spelling out its value from Figure 4, line 3, column 2 (for ease of readability). The result in Figure 5, line 3, column 3 tells us that the effect of the two exhaustivity operators can be vacuous. Similarly to what we discussed for (10), $\mathscr{R}$ can contain for example $\{\neg Exh_{\{B\Diamond p\}}(B\Diamond p), \neg Exh_{\{B\Diamond p\}}(D\Diamond p)\}$ to yield $\neg B\Diamond p \wedge \neg(\neg(D\Diamond p \wedge \neg B\Diamond p))$, which is just $\neg B\Diamond p \wedge D\Diamond p$.

χ	$\mathscr{R}_{\min}$	$Exh_{\mathscr{R}_{\min}}(\chi)$
$\neg Exh_{\{D\Box p,B\Box p\}}(B\Box p)$	$\{\neg Exh_{\{D\Box p,B\Box p\}}(B\Box p)\}$	$\neg B\Box p$
$\neg Exh_{\{D\Box p,B\Box p\}}(D\Box p)$	$\{\neg Exh_{\{D\Box p,B\Box p\}}(D\Box p)\}$	$\neg(D\Box p \wedge \neg B\Box p) \Leftrightarrow_c \top$
$\neg Exh_{\{B\Diamond p\}}(B\Diamond p)$	$\{\neg Exh_{\{B\Diamond p\}}(B\Diamond p)\}$	$\neg B\Diamond p$
$\neg Exh_{\{D\Diamond p\}}(D\Diamond p)$	$\{\neg Exh_{\{D\Diamond p\}}(D\Diamond p)\}$	$\neg D\Diamond p$
cf. $\neg B\Box p$	$\{\neg B\Box p, \neg D\Box p\}$	$\neg B\Box p \wedge D\Box p \Leftrightarrow_c \bot$

Figure 5: Computing the minimally enriched meanings, omitting the subscripts

The main appeal of Magri's system is that it allows us to run pragmatics locally and capture (with the caveat below) the intuition that 'John doesn't allow for the possibility that Bob must be behind his back' in (4g) is odd because it is odd on a local level (cf. $^*D\Box p$). The embedded exhaustivity operator yields a contextual contradiction (Figure 4, line 2), while the negation over it creates a contextual tautology. The caveat is that our rich scalar alternatives allow for a potential escape strategy: it should be possible to escape the tautology during the main-clause exhaustification, by conjoining it with something contingent from the excludable alternatives.[9] To my knowledge this has not been discussed with the non-modal examples, so it is an open question for the system whether this option should be generally blocked.

The presence of a local exhaustivity operator (as in Figure 5, Line 2) is the only option within this system to generate the oddness of (4g). The LF $Exh_{\mathscr{R}}(\neg D\Box p)$ does not generate a con-

[9]There are two maximal ways to extend $\mathscr{R}'_{\min}$. The first option is $\neg Exh_{\{D\Box p,B\Box p\}}(B\Box p)$, which gives $B\Box p$ as the enriched meaning. This is indeed quite impossible intuitively, but the theory allows for it without further constraints. The other option is $\{\neg Exh_{\{D\Box p,B\Box p\}}(D\Diamond p), \neg Exh_{\{D\Box p,B\Box p\}}(B\Diamond p)\}$, which yields $B\Diamond p \wedge \neg D\Box p \wedge \neg B\Box p$ as the final meaning, which is in fact a reasonable candidate.

textual contradiction because $\neg B\Box p$ is semantically weaker than $\neg D\Box p$, and therefore not excludable.

Some flexibility would, however, be useful with negated universal doxastics. While *It's not the case that John thinks that Bob must be behind his back* from (4c) was acceptable, the corresponding sentence with *doesn't think* from (4b) was degraded. To derive this contrast, we can assume that the two have slightly different LFs: (4c) receives the LF in Figure 5, line 1 ($Exh_{\mathscr{R}}(\neg Exh_{\mathscr{R}'}(B_J\Box_i p))$), while (4b) receives the LF in line 5 ($Exh_{\mathscr{R}}(\neg B_J\Box_i p)$).

Are there exceptions to having the exhaustivity operator at every scope site? Magri notes the following contrast and suggests that the difference lies in there being "no space" for an embedded exhaustivity operator within *not all* in (11b).

(11) Situation: In this department, all professors get together at the end of the semester and decide on a grade to assign to all of their students.
  a. It is false that this year all professors assigned an A.
  b. #This year, not all professors assigned an A. (Magri, 2011: p. 38)

While this seems less plausible for main clause verbs (especially non-neg-raising ones), other factors such as prosody can shape the LF and could therefore in principle play a role in the conditions on exhaustification as well. Consider for example (12), read with a "B accent" (rise-fall-rise, cf. *All politicians aren't corrupt*), which triggers a wide-scope negation (Büring, 1997). A possible explanation for the oddness of (12) is that it lacks, like (11b), an embedded exhaustivity operator.

(12) **All Italians don't come from a warm country.* (rise-fall-rise intonation)

The question that I leave open at this point, though, is why $\neg D\Box p$ should have an obligatory embedded exhaustivity operator (under the matrix negation), while $\neg B\Box p$ seems to show some optionality in this respect, given (4b) vs (4c). The main difference between the two, though, is that an embedded exhaustivity operator with $\neg D\Box p$ yields a contradiction ($D\Box p$ is odd), as in Figure 4, line 2. This could perhaps be exploited when formulating local conditions under which an exhaustivity operator cannot be deleted.

5. Conclusion

In this paper, I have discussed the limited distribution of epistemic modals under the Slovenian verb *dopuščati* ('allow for the possibility'), which I have analysed as an existential doxastic attitude. The goal was to explain the cases of unacceptability of embedded universal epistemic modals under *dopuščati*. Using the ideas in Močnik (2019), I have revised the contribution of epistemic modals. The relevant consequence of this revision was that embedded universal (but not existential) epistemics collapsed the choice of attitude verb.

The core idea explored in this paper was that sentences like **Dopuščam, da mora deževati* ('I allow for the possibility that it must be raining') share their source of oddness with the more well-known **Some Italians come from a warm country* (Magri, 2009, 2011). The oddness arose from a contextual contradiction due to an obligatory scalar implicature.

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(Non-)exhaustivity in embedded questions: Contextual, lexical and structural factors[1]

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Abstract. *Wh*-questions often allow for either a Mention-Some (MS) or a Mention-All (MA) answer/interpretation, but what licenses MS answers remains unclear. In this paper, we systematically investigate a set of linguistic (*wh*-word, matrix verb, modality/non-finiteness) and discourse/contextual (questioner goals) factors that give rise to MS reading. We present evidence from two experiments showing that MS readings of embedded questions are not only available across various forms of embedded question, but also in environments that have been claimed not to license MS readings: specifically, finite clause embedded *who*-questions (e.g., *Mary knows who came to the party*). Moreover, acceptability of both MS and MA is influenced by contextual information. These results thus call into question a strictly semantic approach towards the resolution and interpretation of *wh*-questions, and an approach that claims obligatory licensing of MS by modals, and at the same time, provide empirical support for theories that incorporate the role of a speaker's context-dependent discourse goals.

Keywords: questions, embedded questions, mention some, non-exhaustivity.

1. Introduction

The truth-conditions of *wh*-questions, and more specifically, their embedded counterparts as in (1), have been the source of debate amongst semanticists over the past half century (Groenendijk and Stokhof, 1982, 1984; Hintikka, 1976).

(1) Mary knows **where to find an Italian newspaper**.

It is perhaps not surprising that the truth of (1) depends on the possible answers to the root question *Where can I find an Italian newspaper?* If there are four places where one can find an Italian newspaper, then the question is said to exhaustively specify that set of locations (see Groenendijk and Stokhof, 1984; Karttunen, 1977).[2] Thus, for (1) to be judged true, Mary must know (or demonstrate knowledge of) all four places. We could, however, also identify a second reading where Mary's knowledge need not be exhaustive. (1) may be true in a situation where Mary knows *at least one* true location. These two readings are known as **Mention-All** (MA) and **Mention-Some** (MS) answers, respectively (Hintikka, 1978).

This indeterminacy linked to how many answers Mary must know in order for (1) to be judged true can be resolved when we consider the larger discourse context and what kind of answer might satisfy the questioner's goals. If a tourist in town for a day asks Mary, *Where can I find an Italian newspaper?* it may suffice for Mary to name a single, nearby, shop (that is open). In contrast, if an economist interested in the local newspaper market or a realtor seeking to

[1] We are grateful to the research assistants in the Rutgers Laboratory for Developmental Language Studies for helping to design and administer these studies. We would like to thank audiences at Sinn und Bedeutung 23, Rutgers University, and Chicago Linguistic Society 54. Finally, thanks goes to Tim Dawson for his help in implementing the design for Experiment 2.
[2] We abstract away from issues of exhaustivity strength in order to focus on the distinction between non-exhaustive and exhaustive readings. For summary of debates on exhaustive readings, see (e.g., Klinedinst and Rothschild, 2011; Dayal 2016; George, 2011, Xiang, 2016).

determine whether Italian families will acclimate to the neighborhood asks the very same question, their goals likely require an exhaustive response from Mary. To wit, the truth-value judgment of (1) depends on the alignment between contextually-relevant discourse goals, and the answers that Mary gives to the question.

Now, while some questions, such as the embedded question in (1), or its root question counterpart, permit either MS or MA answers, other questions are more restrictive and seem to require an MS answer. Consider the sentence in (2).

(2) Mary knows **who came to the party**.

The presence of an MA reading for (2) is uncontroversial: every semantic theory (Beck and Rullmann, 1999; George, 2011; Groenendijk and Stokhof, 1982, 1984; Guerzoni and Sharvit, 2007; Hamblin, 1973; Heim, 1994; Karttunen, 1977; Klinedinst and Rothschild, 2011; Lahiri, 2002; Nicolae, 2013; Spector and Égre, 2015; Theiler, 2014; Uegaki, 2015; Xiang, 2016) predicts MA answers (with varying levels of exhaustivity, which we do not address here) to be permitted. By contrast, it been claimed to lack the MS reading (Fox, 2014; George, 2011). The question is *why*. In comparing (1) and (2), we can observe two surface-level differences: the *wh*-word and the finiteness of the embedded clause. There is also the issue of what is at stake: why are we asking about newspaper vendors or party attendees? What's more, embedded questions can be the complement of different embedding verbs, *know* among them. It is unclear what precisely the role of these factors is in MS answer licensing and MA answer requirement.

These factors would be assigned a different role of varying influence and centrality, depending on the theoretical approach to MA/MS readings in questions. Thus, it is imperative to carefully identify their contribution, whatever one's theoretical framework, in order to determine their contribution. We take space here to spell out in rough detail a number of major formal approaches to the study of MS/MA. We name the approaches based on the general features of how the theory accounts for MS.

First, general linguistic *ambiguity* approaches (Beck and Rullmann, 1999; George, 2011) posit at least two logical forms for each reading. Such a general ambiguity approach predicts that MS and MA readings should be equally available in any question regardless of form, *modulo* the context and the verb's selectional restrictions (George, 2011; Grimshaw, 1979). A more specific version of this approach holds that only *modal* questions are ambiguous (George, 2011; Fox, 2014; Xiang, 2016), and since non-finite clauses are said to be modal, then (1) permits both MS and MA in contrast to (2). A strong modal approach would predict that the MS reading will *only* be available in modal questions, as the ambiguity arises due to an interaction with a modal in the LF.

In contrast, *underspecification* approaches (Asher and Lascarides, 1998; Lahiri, 2002; van Rooij, 2003) posit a single representation whose logical form is semantically unspecified for exhaustivity. For example, Asher and Lascarides (1998) propose that information provided by semantics is weaker than that provided by pragmatics; pragmatics provides a *strengthening* of semantics. For them, the logical form allows both exhaustive and non-exhaustive answers and thus imposes no exhaustivity requirement *per se*. The prediction is that any given reading should be available whenever the relevant *contextual* factors license it, regardless of question form.[3] Finally, *pragmatic* approaches (Groenendijk and Stokhof, 1982, 1984) hold that the semantic contribution of a question is always exhaustive, and a non-exhaustive meaning/answer is permitted when the context licenses *weakening*. Given these contrasting approaches to question/answer dynamics, our goal is to present empirical evidence for the individual contributions of the factors identified above in licensing MS answers. By so doing, we hope to adjudicate between theories and flesh out the balance between semantics and pragmatics in question/answer relations.

In this paper, we present two sets of experiments that quantify both the linguistic and contextual discourse factors that modulate the availability of MS readings of embedded *wh*-questions. In Section 2, we carefully outline these factors, including discussion about each from the literature. Our focus will be on embedded questions. In Section 3, we present Experiment 1, which establishes a baseline to identify how generalizable the MS reading actually is (data that has, up to this point, been missing from discussions). To preview our findings, we show that the factors we have isolated do indeed modulate acceptability, and crucially, that while the presence of a modal boosts acceptability of MS readings, the absence of a modal does not yield categorical rejection of MS interpretations. In Section 4, we present Experiment 2, in which we manipulate the context and shows that exhaustivity in *wh*-questions is influenced by the speaker's goals in asking the question. We conclude in Section 5.

2. Semantics and Pragmatics of Questions: Linguistic and Discourse Licensors

Three factors that have been argued to modulate the availability of the MS reading in embedded questions include the matrix verb that embeds the question, the *wh*-word heading the question, and the presence of a modal element in the embedded question. We discuss each of these before turning to a fourth, contextual factor.

2.1. Linguistic Cues to interpretation

2.1.1. Matrix verbs

Clausal embedding verbs like *know* are known for their syntactic and semantic selectional restrictions (Grimshaw, 1979). *Know* can syntactically embed a question (e.g., *know who came to the party*) or a proposition (e.g., *know that Sam came to the party*). In contrast, a verb like *wonder* can only embed a question (*wonder whether/who* ... vs. **wonder that*...). Some theoreticians have supposed that the distributional differences between readings of embedded questions arise from similar semantic restrictions. This discussion has typically revolved around three levels of exhaustivity (i.e., weak, intermediate, strong), and whether the distribution of those readings under different verbs is revealing about the semantic representation of *wh*-questions (see George, 2011; Guerzoni and Sharvit, 2007; Heim, 1994; Klinedinst and Rothschild, 2011; Lahiri, 2002; Spector and Egré, 2015). It is generally accepted by semanticists that some level of exhaustive reading is available for *know-wh*; it is often argued that a strong exhaustive reading is most available. However, Cremers and Chemla (2016) showed experimentally that *know-wh* actually gives rise to the range of exhaustive readings.

In contrast to *know*, some verbs, for example *predict*, are argued to prefer only weak exhaustive readings (Beck and Rullmann, 1999; Heim, 1994; Klinedinst and Rothschild, 2011; Sharvit,

[3] We discuss more specifically which contextual factors matter in Section 2.2.

2002). George (2011) argues that questions are ambiguous between a (strong) MA and an MS reading, and verbs will select for one (i.e., for the X-operator in the MA representation) or none. According to this account, weak exhaustivity is equivalent to the MS meaning. Thus, *predict* selects for MS, while *know* selects for MA. However, given that MS does easily arise in questions with *know* as in (1), we may question the power of these selectional restrictions on their own.

2.1.2. *Wh*-word

As we pointed out in the comparison between (1) and (2), one difference between these embedded questions lies in the type of *wh*-word. In fact, there are observations appearing throughout the literature suggesting that differences in the *wh*-word hearing embedded questions yield differences in judgments of (non-)exhaustivity. See, for example, Ginzburg (1995a, b) and Asher and Lascarides (1998). Constructed examples presented in support of MA readings usually feature *who*-questions, as in (2), while examples in support of MS readings feature *where*-questions, as in (1)—or more generally, non-*who*-questions. However, nothing about the lexical semantics of these *wh*-words predicts differences in exhaustivity, so these observations are curious. Consider, for example, (3), from Asher and Lascarides (1998):

(3) John knows **how to get to the treasure**.

It seems natural to interpret (3) as true just in case John knows at least one way (any way) to get to the treasure, and unreasonable that he should know all of the possible ways to get to the treasure. What matters is that John is able to find a way to the treasure.

Asher and Lascarides discuss the possibility that *wh*-words might encode preferences for resolving exhaustivity in certain ways (i.e., that *who*-questions are exhaustive), but that these preferences may be overridden by contexts that make explicit a questioner's goals and mental state. However, they argue given the variability of interpretations observed, a unified question semantics should provide a weak (monotonic) meaning (a non-exhaustive one). This may then be strengthened via pragmatics (to an exhaustive reading) given the questioner's plans and cognitive state, rather than the other way around (p. 262). This last aspect is crucial to their account, so we return to it in Section 2.2, which addresses discourse goals.

Further differences between *wh*-words may be observed in how the referential domain of a *wh*-word is determined. This may influence whether an MS reading is possible. For example, Ginzburg (1995a) notes that *who*- and *where*-phrases differ in the granularity of their referential domains. Consider the two contexts and in (4) and (5).

(4) a. Mary has just stepped off a plane in Helsinki.
b. Flight Attendant: Do you know **where** you are?
c. Mary: Helsinki.

(5) a. Mary has just gotten out of a taxi in front of her hotel.
b. Taxi Driver: Do you know **where** you are?
c. Mary: Helsinki.

(6) Mary knows **where** she is.

(6) seems true in (4), but false in (5). According to Ginzburg, *where* is vague with respect to specificity of location, while *who* typically only refers to individuals.[4] Though he does not relate this directly to MS/MA, he notes that with *where* questions, the questioner's contextually-provided goals determine the level of granularity appropriate.

However, we might create comparable scenarios with *who* questions, which also demonstrate granularity effects. Consider the following fictional scenarios.

(7) a. Luke Skywalker is talking to Han Solo about his dismay concerning the Galactic Empire's attempts to purge the galaxy of the Jedi. A menacing character dressed in all black with a breathing mask is suddenly revealed.
b. Han Solo: Do you know **who that is**?
c. Luke: Darth Vader.

(8) a. Luke Skywalker is expressing his despair to Obi-wan Kenobi about his lost opportunity to ever have one final moment to see his father. A menacing character dressed in all black with a breathing mask is suddenly revealed.
b. Obi-Wan: Do you know **who that is**?
c. Luke: Darth Vader.

(9) Luke knows **who that is**.

Just as with (6), we might argue that the truth of (9) depends on whether it is a response to (7) or (8): (9) appears to be true and felicitous in (7) but seems true but infelicitous in (8). As in (5), the response in (8) seems out of place, like the person who utters the embedded question is missing or not clued in on something. While we admit that this case is slightly different from Ginzburg's, it serves to demonstrate that for both *where* and *who*, the context may determine the level of specificity or granularity with which an embedded question is acceptable.

In a similar vein, we can also cite *who*-questions that seem to be naturally interpreted on an MS reading, as the examples in (10) and (11) show.

(10) Who's got a light? (Groenedijk and Stokhof, 1984; van Rooij, 2003)
(11) I need a ride. Who's going to the party? (Dayal, 2016; p.c.)

Both questions are headed by *who*, and yet both permit an MS answer. If one person steps forward and truthfully offers, "Me," the speaker should be satisfied.

Likewise, Asher and Lascarides discuss another example where we naturally have a non-exhaustive *know-who*. Imagine that Jill is a gossip columnist, writing on the celebrities who attended Elton John's party. (12) can be true even if Jill doesn't know any cameramen who were at the party.

(12) Jill knows who attended the post-Oscar party at Elton John's house.

Some might argue that (12) reveals an exhaustive answer when the domain is restricted to the set of celebrities (e.g., *who [of the celebrities/relevant party-goers] attended the post-Oscar*

[4] Ginzburg does not present a comparable example with *who* to show that a similar scenario with *who* cannot give rise to the same effects.

party?) (see discussion in George, 2011, Section 6.2). However, if this is the case, it is still unclear how domain restriction alone could be the determining factor and why with rampant domain restriction in natural language (e.g., with quantifiers and definite descriptions), MS readings still seem to be blocked in same cases but not others.

Domain restriction of the set picked out by *who* also does not seem to readily explain other examples we might create, where an MS answer seems felicitous. Consider the following scenario.[5] Imagine that our friend Mark is incredibly cliquish, and typically only invites philosophers to his parties. I am trying to prove that he's biased, while you are defending him. In fact, Mark had a party just last night, so we have the following dialogue in (13).

(13) a. Me: Who came to the party last night? / Who was invited to the party last night?
b. Jill, a linguist.

Note that your response in (13b) is both felicitous and non-exhaustive. When I ask either question in (13a), I may intend a restriction to the set of philosophers (i.e., *who, of the philosophers*), because of my beliefs about Mark.[6] Indeed, this set would be the natural restriction available from the common ground (cf. von Fintel, 1994). Alternatively, one might argue that the restriction is to the set of party goers, thus if a linguist went, then a linguist is included in the restriction. On the first restriction, (13b) should be odd. On the second, (13b) should no longer be odd, but this posited restriction now misaligns with the intent behind my question, namely, to show that Mark only invited philosophers.[7] No obvious semantic mechanism is present to trigger the restriction.

What exactly is changing between these examples such that the truth conditions of embedded question reports seem starkly different, and the felicity of MS answers varies? Let us suggest that for any question, we can construct a context where discourse goals license non-exhaustivity. It is the contribution of these discourse goals that matters and give rise to interesting interactions with the linguistic features of the (embedded) question.

While levels of granularity and exhaustivity may be different sorts of beasts, they share one salient commonality: in order to establish truth conditional content, precisification of the speaker's referential intent is necessary. A hearer must recruit whatever information is available to them in order to resolve the intended level of granularity/specificity. This could include information conveyed in the linguistic form of her utterance as well as any contextual information that may elucidate the speaker's goals.

Finally, it has also been observed that the availability of MS readings can be conditioned by the use of a D-linked *wh*-phrase (Pesetsky, 1987). While we do not manipulate this factor in our studies, as we focus on *who* and *where*, we take some space here to remark on the contrast. While a singular-marked *which* phrase (e.g., *which child*) can give rise to both MA and MS readings (although it is unclear whether they have equivalent availability, see Dayal (2016) and Groenendijk and Stokhof (1984)), Comorovski (1996) observes, as does Spector (2007), that

[5] Thanks to Caley Howland for bringing this scenario to our attention.
[6] To boot, I may even plausibly intend you to give me an exhaustive answer. However, again, not only is your answer felicitous but it's non-exhaustive as well.
[7] A third candidate explanation might be possible. You may think that a restriction is to the *complement* of the contextually available set, (i.e., any non-philosophers). There may be independent reasons to prevent this kind of move. Further, the question remains nonetheless of how this kind of restriction is licensed.

plural-marked *which*-phrases (e.g., *which places*) block an MS answer (as opposed to monomorphemic *who*-phrases). Xiang and Cremers (2016) provide tentative evidence for this claim. They also found that the presence of a modal facilitated MS readings only with *who*, but not with plural *which N* phrases (e.g., *Mary remembered {which children/who} can lead the dance* vs. *Mary remembered {which children/who} have an accessory in common*).

However, aspects of the experimental design may have led to, or at least influenced, this pattern. Notably, the modal predicate *can lead the dance* was explicitly included in the lead-in and as part of the visual stimuli prior to appearing in the target statement, while the non-modal predicate *have an accessory in common* never did. As a result, in the non-modal condition, participants may have had to undergo additional inferences to calculate both Mary's perspective and what she remembers, given that this information was not explicitly stated. It is possible that the additional task demands involved in this condition incur processing costs, resulting in the observed response patterns. Moreover, the two predicates *have an accessory* and *lead the dance* were not fully crossed for presence/absence of a modal, so a tight comparison between the two conditions cannot be made. Given that these design points leave open questions open about the source of the results, we consider it empirically unresolved as to whether and to what extent these factors give rise to an MS reading.

2.1.3. Modals and non-finite clauses

Perhaps the most robust explanation for cuing non-exhaustivity is the presence of a modal (Fox, 2014; George, 2011; Nicolae, 2013; Xiang, 2016). The aspects of the modal relevant for non-exhaustivity are both its existential force and the contextually-determined conversational background, which provides a goal-oriented interpretation. The conversational background is comprised of a modal base, which picks out the set of worlds where the prejacent φ in *can* φ is satisfied, and an ordering over those worlds, determined by the deontic flavor of *can* (Kratzer, 1981; 1991). In Portner's (2009) classification, these are the existential priority modals.

While the example in (1) does not seem to have a modal in it, it can easily be paraphrased with the modal *can* (*Mary knows where she can find an Italian newspaper*); both forms allow MS. This comparison highlights the natural relationship between infinitival clauses and modality, and supports Bhatt's (1999) proposal that infinitival clauses contain *covert* modals. Bhatt enriched the Kratzerian picture to capture this goal-orientedness in infinitival clauses by contextually restricting the modal base to the worlds where not only φ is true, but where the agent's actions maximize the likely satisfaction of their goals. Bhatt further notes (fn. 12, pg. 140), that non-exhaustivity is linked to the absence of indicative tense. Following this logic, the fact that (1) contains an embedded infinitival, while (2) has neither a covert nor an overt modal, could explain the perceived difference in MS acceptability between the two.

Semantic theories that support the modal account attribute the MS/MA ambiguity to a scope interaction between an exhaustivity operator and the modal (George, 2011; Nicolae, 2013; Xiang, 2016). Essentially, the MS reading is derived when the modal takes wide scope. A natural assumption here is that non-modal questions do not give rise to these scope interactions, and thus cannot give rise to MS readings. While our experimental data do not definitively adjudicate between these particular accounts, we briefly highlight their main points, because our data bear on their viability insofar as we illuminate the contribution of the modal.

George (2011) proposes that the modal (or an existential quantifier) syntactically scopes over an exhaustivity operator X by undergoing Quantifier Raising (May, 1985). Nicolae (2013) proposes that the modal quantifies into a subset of the *wh*-domain such that, for each possible subset, it constitutes a maximally informative answer.[8] For her, these readings are licensed via presupposition failure when the context fails to provide a maximally informative answer. In contrast to these two syntactic approaches, Xiang's proposal achieves a *semantic* scope effect without QR, via a type-shifting operator LIFT, modified from the type-lifting operator employed in continuation-based grammars (Barker, 2002; Barker and Shan, 2014; Charlow, 2014; Shan 2004; Shan and Barker, 2006), which is in turn modified from Partee's (1986) LIFT. Here, the competing operator is the trace of the *wh*-word: a type-lifted *wh*-trace out-scopes the modal to derive the MA reading; while a non-type-lifted trace is out-scoped by the modal to derive the MS reading.

2.2. Discourse Cues to Interpretation

We have suggested that a common theme across the cases we have considered is that any perceived preference for (non-)exhaustivity may be the result (at least in part) of the context highlighting non-exhaustive discourse goals. Some have even argued that semantic interpretation of a question relies crucially on contextual aspects of discourse—namely, the speaker/questioner's goals that drive the search for information. For example, Ginzburg (1995) argues that question interpretation is governed by what *resolves* the question, which depends on the questioner's goals and her mental state. His notion of *resolution* is dependent on contextually-determined factors. Asher and Lascarides (1998) similarly argue that the questioner's cognitive state and plan (what she intends to do with the answer she receives to her question) are crucial. On both accounts, these factors enter into determining both the appropriateness of answers to root questions, and the interpretation of embedded questions. Finally, van Rooij (2003) formalizes this issue using the game-theoretic notion of decision problems, and Bayesian decision theory (Savage, 1954), where interpretation is governed by its utility in resolving the questioner's goal/problem. These notions allow what counts as a suitable answer to vary with context, and further highlight the importance of mental states in evaluation (cf. Boër and Lycan, 1985).

Our review of the linguistic and discourse factors in this section has revealed significant variability in the availability of MS readings, and the extent to which this availability is influenced by (and may even depend on) linguistic factors, such as the embedding matrix verb, the *wh*-word heading the question, and the presence/absence of a modal element, and on higher-level features of the discourse context, including the questioner's goal—which we argue is central. We crucially observe that for any question which seems to semantically block MS, we can nonetheless construct a context where explicit discourse goals make MS natural to a degree.

Thus, we are left asking how systematic and robust are the linguistic constraints on MS, and to what extent context exerts an influence? That is, to what extent is (non-)exhaustivity derived from or licensed by the linguistic form of the question, and to what extent can context override the influence of these linguistic cues? We conducted two sets of experiments to answer these questions. In Experiment 1, we establish the baseline contribution of the three surface-level

[8] Several problems have been identified with QR approaches. The main objection is that while existential quantifiers are found to undergo QR, modals are typically not. See e.g., Fox (2014), or Dayal (2016) for discussion.

linguistic cues. In Experiment 2, we provide evidence that discourse goals play a role and can in fact override constraints associated with the linguistic form of the question.

3. Experiment 1: Surface-level linguistic cues to interpretation

Experiment 1 focuses on linguistic cues, by manipulating the matrix verb (*know*, *predict*), the *wh*-word (*who*, *where*), and the finiteness of the embedded clause (+FIN, -FIN), in embedded question reports to determine the effect of each factor on the availability of MS.

3.1. Methods

3.1.1. Design & Materials

The experiment had a 2x2x2x4 design with three Question form factors Matrix Verb (*know*, *predict*), *Wh*-Word (*who*, *where*), and Finiteness of embedded clause (+FIN, –FIN), and Answer type: Mention-All (MA), Mention-Some (MS), Mention-All+False Report (MA+F), and False Report (FR). These four Answer types differ in how many answers a character provides in the specific trial. FRs were included as a control. Finiteness was the only factor manipulated between subjects, in order to make sure that there was no influence of this factor within a participant's experimental session. Contexts were minimally changed across this factor to satisfy the felicity conditions of finite/non-finite clauses. An example of a trial with *know*, *where*, –FIN and an MS Answer appears in (14).

(14) The places that serve cappuccinos around the neighborhood are A, B, C, and D. E and F do not. Mary usually gets her cappuccino at D. Jane is going to be in the neighborhood tomorrow. She loves cappuccinos, and texts Mary to ask where to get a cappuccino. Mary responds, "D."

Jane reports, "Mary knows where to find cappuccinos."
Is Jane right?

There were eight total sentence frames, for every possible combination of the three factors pertaining to question form. The target sentences featured eight different embedded verbs following the *wh*-word to allow for generalization across predicates within the embedded clause (e.g., *where*: *find*, *view*; *who*: *ask*, *invite*, etc.). This manipulation yielded a total of 64 unique sentence tokens. Stimuli were assigned to four lists in a pseudo-randomized Latin square fashion. In addition to the 64 unique test items, there were 10 root question filler sentences of the form *Which of the following X is not Y?*, with four possible answers listed. Filler questions served as comprehension and attention checks and addressed common world-knowledge based category membership, for example, *Which of the creatures is not a mammal?*

3.1.2. Participants and Procedure

232 undergraduates enrolled in introductory-level courses were recruited from the Rutgers University Linguistics and Cognitive Science subject pool. 14 participants were removed from final analysis for non-native speaker status. The experiment was designed and administered using Qualtrics survey software. Each participant was run in a quiet laboratory setting, seated

at an iMac. Participants were asked to read a series of brief contexts, and after each one, respond to a question corresponding to a preceding statement. Each context was comprised of 3-4 sentences, and ended with a question. A person then delivered an answer to the question, corresponding to one of the Answer types manipulated. Participants chose either 'Yes' or 'No' in response to the prompt (e.g., *Is Jane right?*). (See (14) above.)

3.2. Predictions

Accounts that assume ambiguity of possible answer predict no difference in responses based on question form manipulations; nor do they in principle predict any difference between the Answer types. However, given the robust sense from the literature that MA answers are generally available by default, we might expect to see a higher percentage of 'yes' answers, given an MA answer than an MS answer. By contrast, accounts that hold that MS answer availability is tied to the presence of a modal would predict that non-modal (+FIN) questions should *not* permit MS answers, and participants should categorically answer 'no' with these questions, but 'yes' with –FIN questions, *modulo* other factors. Accounts that attribute stronger exhaustivity requirements to *know* than e.g., to *predict* (George, 2011; Cremers and Chemla, 2016) might predict fewer 'yes' answers in response to MS answers for the former relative to the latter. Accounts such as those espoused by Asher and Lascarides (1998) and Ginzburg (1995) would predict that 'yes' responses to MS answers would surface more often with *where* questions than with *who* questions. All accounts would predict that the presence of false information —especially in an entirely false report—should generate a significant percentage of 'no' answers. It is an open question whether or not a combination of accurate and false reports (a weak exhaustive answer) would be permitted, allowing an affirmative response to the question. Experimental results from Cremers and Chemla (2016, 2017) and Phillips and George (2018) indeed revealed high rejection rates, though not as high as false controls. Klinedinst and Rothschild (2011) also conducted a small survey and found that participants accepted weak, intermediate, and strong exhaustive readings with *predict*. We predict that these mixed reports will also receive degraded acceptability. Accounts requiring *know* to be strongly exhaustive would predict uniform rejection of all FR-type answers.

3.3. Results

Experiment 1 results are presented in Figure 1. Each graph corresponds to a factor tested.

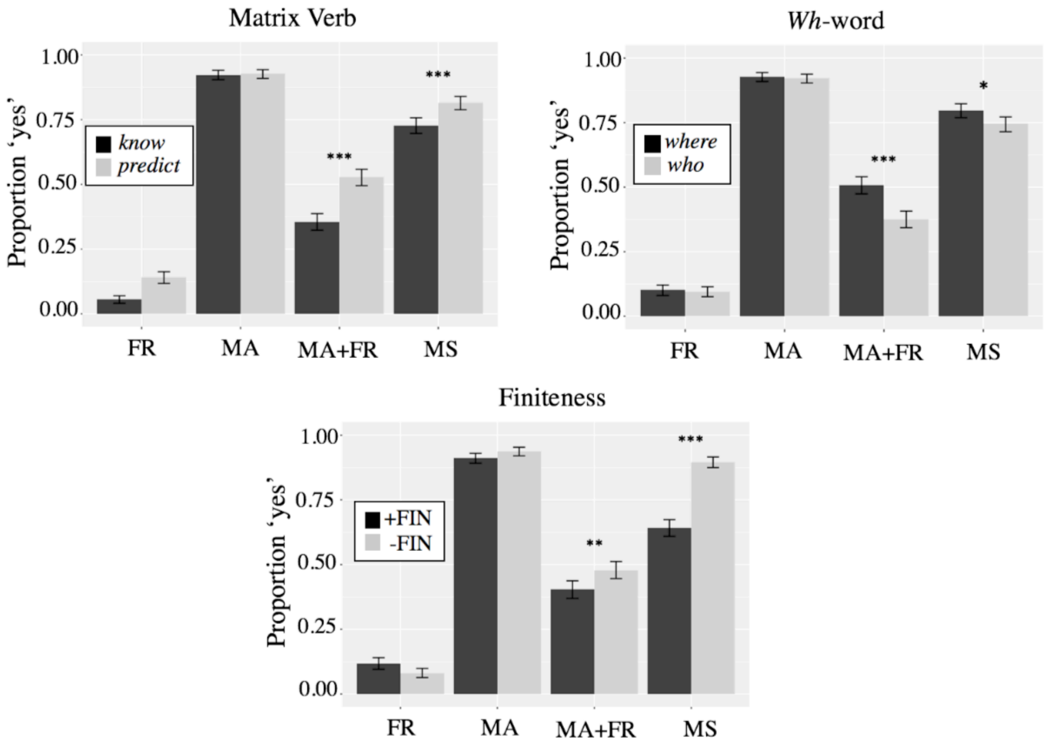

Figure 1: Experiment 1 results given three question form factors and 4 answer types.

All analyses conducted were non-parametric Kruskal-Wallis tests. We found overall main effects of Verb ($(X^2 1) = 53.714$, $p<0.0001$), *Wh*-word $X^2(1) = 9.71$, $p<0.005$), ±FIN ($(X^2 1) = 43.567$, $p<0.0001$), and Answer ($(X^2(3) = 823.42$, $p<0.0001$). Breaking down each factor per Answer, all effects are significant for both MS and MA+FR: Verb (MS: X^2 (1) = 18.892, $p<0.0001$; MA+FR: $X^2(1) = 51.731$, $p<0.0001$); *Wh*-word (MS: $X^2(1) = 6.61$, $p<0.05$; MA+FR: $X^2(1) = 30.219$, $p<0.0001$); and ±FIN (MS: $X^2(1) = 156.7$, $p<0.0001$; MA+FR: $X^2(1) = 9.513$, $p<0.005$). We then zoomed in on the critical MS Answer condition, as shown in Figure 2. Here too, all factors were significant: Verb ($X^2(1) = 18.892$, $p<0.0001$), *Wh*-Word ($X^2(1) = 6.61$, $p<0.05$), and ±FIN ($X^2(1) = 156.7$, $p<0.0001$).

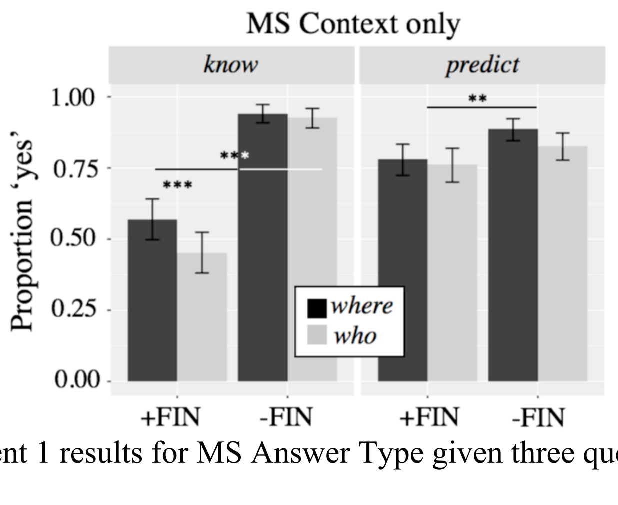

Figure 2: Experiment 1 results for MS Answer Type given three question form factors.

3.4. Discussion

The results of Experiment 1 demonstrated that the form of the speaker's question matters for the types of answer provided by the addressee. There were significant effects of all factors. Whereas MA answers were consistently supported across factor types and conditions, and FRs led answers to be degraded, the locus of the action was in MS answers. In particular, the presence of an infinitival (–FIN) embedded clause boosted MS acceptability in comparison to +FIN clauses. At the same time, however, the acceptance rate in +FIN clauses was far from 0%—indeed, it was over 50%. Thus, while the difference in acceptability lends partial support to a modal account, insofar as infinitival clauses are modal, it is only partial, since MS answers are not categorically ruled out with finite embedded questions.

While there was an effect of Finiteness for both *know* and *predict,* the effect was more pronounced for *know-wh*: for MS answers, there was a depression in acceptance (but not complete rejection) with +FIN *know-wh*. These results could be taken as providing initial evidence in support of accounts based on ambiguity and/or underspecification, which both predict MS to be (nearly) as widely available as MA, given appropriate contextual licensing.

Both ambiguity and underspecification accounts admit the role of the context. It is possible that the non-categorical judgments we observed in Experiment 1 indicate that the underlying representations are underspecified for exhaustivity, and pragmatics fills that value.[9] To tease apart these theoretical approaches and better pin down the division of labor between semantics and pragmatics, we require a better understanding of the extent to which context licenses certain answers regardless of question form. We now turn to Experiment 2.

In Experiment 2, we investigate the role of the questioner's goals by manipulating contextual information. We refer to "high-stakes" and "low-stakes" contexts, because what's at stake influences the goal(s) at hand, and consequently, what kind of answer can resolve the question. We define a High Stakes context as one where human health or lives are at risk, while we define a Low Stakes context as one without any such life-threatening issue (for instance, choosing a good diner or hair salon). By design, in our High Stakes contexts, the goal is to ascertain as much information as possible, therefore an MA answer is most informative. In contrast, our Low Stakes contexts present goals where multiple answers are possible, thus an MS answer not only suffices, but may be preferred. In addition, we manipulated the level of informativity of MS answers in order to tease apart the types of answers that could resolve the question, since we assumed that not just any MS answer would suffice in any context.

We note two things about our notion of Stakes. First, it is not isomorphic to exhaustivity. It is possible in principle to have a High Stakes context where the Questioner's goals are non-exhaustive, and a Low Stakes context where the goals are exhaustive. For example, this difference might arise under constraint of time pressure, or where a High Stakes goal may only be satisfied by a single person, etc. Nonetheless, one might assume that in most cases, when the stakes are High, one values above all an answer that is not only true, but thorough. Second, we recognize that what counts as High or Low Stakes is also context-dependent. However, this approach at least gives us a first look at the contribution of contextually-relevant goals and their influence on answer reports.

[9] See discussion in Sprouse (2007), Sprouse et al. (2012) for arguments about gradient vs. categorical grammaticality judgments in syntax and what they might indicate about the underlying representations.

In addition to the manipulation of context, we also manipulated – as we did in Experiment 1— the form of the answer. However, here, we introduced a further manipulation in MS type. Xiang (2016) has claimed that an answer that is not a singleton MS answer (a Mention-One answer, MO) but is not exhaustive is "unacceptable" and must be "ignorance-marked." We therefore controlled for whether non-exhaustive answers were MO or MS (mention-a-few). While we recognize that there could be contexts in which a non-MO answer could signal ignorance on the part of the speaker, here the contrast between MO/MS and MA could diffuse the MO/MS contrast.

4. Experiment 2: Discourse-level cues to interpretation

4.1. Methods

4.1.1. Participants and Procedure

318 native speakers of English participated. The study was constructed and administered using Alex Drummond's Ibex Farm platform. Participants were recruited online through Amazon Mechanical Turk. IP addresses were restricted to US only, and further questions were included to ascertain native speaker status. 6 participants were removed for browser incompatibility issues, and 6 participants were removed for non-native English speaker status.

4.1.2. Materials and Procedure

As in Experiment 1, in Experiment 2 we manipulated Finiteness in target sentences as a between-subjects factor. The –FIN target condition contained three within-subjects factors: Answer Type (Mention-All (MA), Mention-Some (MS), Mention-One (MO), and False Report (FR)), Informativity (MAX, MIN, for MO/MS Answers), and Stakes (High, Low). The +FIN target condition had two within-subjects factors (Answer Type and Informativity). We did not manipulate Stakes in the +FIN condition, and only targeted Low Stakes for the following reason: we predicted that in a High Stakes condition, an MA answer would be favored. Given that +FIN embedded questions already favor MA answers, we would predict to see little to no change. The question is whether a Low Stakes context can pull answers away from MA towards MO/MS. For both conditions, we included both Mention-Some Answer Types, where two answers were given, and Mention-One Answer Types, where a singleton answer was given.

Each context featured a main topic, a main character conducting a search form some contextually-relevant information, and a set of ranked entities relevant to the topic. The main character in search of the information posed a *wh*-question to a group of individuals, who then each provided an answer connected to the ranking. The participant's task was to evaluate the knowledge of these individuals, based on their answers and the given context.

The Answer Type and Informativity manipulations yielded 6 possible answers in the set of answers, which were randomized so that the same answers did not always appear together, and so that participants would see different answers for each story. Thus, there were six answer type permutations. At any given time, only three Answer Types were randomly displayed by an algorithm, in order to reduce the cognitive load on the experimental participants, and to ensure that it was not the case that the same types were always pitted against each other (thereby forcing certain comparisons and reducing the probability of a response bias from surfacing on every trial). An example of a High Stakes and a Low Stakes trial type follow.

(15) *High Stakes Trial Type*
Scientists have discovered a new strain of a dangerous virus that has contaminated oysters in the Mid-Atlantic. The Center for Disease Control is trying to prevent as much contamination as possible by tracking down all the oysters. In this area, luckily only 6 restaurants usually buy oysters from the contaminated area: Restaurant A ordered 10 crates, Restaurant B ordered 8, Restaurant C ordered 5, Restaurant D ordered 2, Restaurant E ordered 1, Restaurant F ordered 0.

The supervisor for this county asks his inspectors, "Where should we check for contaminated oysters?"

Inspector A says, "Restaurant A, B, C, D and E."	MA
Inspector B says, "Restaurant A."	MO-MAX
Inspector C says, "Restaurants D and E."	MS-MIN

Who knows where to look for oysters? (Choose all that apply.)

(16) *Low Stakes trial type*
Johanna is new to Minneapolis and wants to try local coffee shops. The Ultimate Coffee Guide 2018 ranks cafes on a ten-point scale, where ten is the highest number of points. Minneapolis has the following ranking for coffee roasteries: Café A has 10 stars, Café B has 8, Café C has 5, Café D has 2, Café E has 1, Café F has 0.

Johanna asks three of her classmates originally from the city, "Where should I go for coffee?"

Classmate A says, "Cafés A and B."	MS-MAX
Classmate B says, "Cafés E."	MO-MIN
Classmate C says, "Café F."	FR

Who knows where to go for coffee? (Choose all that apply.)

At the end of each trial, participants were instructed to answer the question about the individuals' knowledge by *choosing all that apply*. There was also a "None of the above" option. This multiple-choice question allowed participants to choose more than one answer, allowing us to determine if multiple answer types were permitted in a given scenario.

4.2. Predictions

Given the theoretical approaches reviewed earlier, we might make the following predictions regarding the influence of context and informativity on acceptability of answer type. We first spell out predictions regarding contextual Stakes. An Ambiguity theory might predict that either reading will be licensed, and that context simply pulls out one reading over the other. Thus, these accounts might expect no difference between different question forms (–FIN and +FIN conditions), but rather have all differences housed between High and Low Stakes. Underspecification theories also predict that a reading will be as available as made appropriate by context (contextual goals), thus differences should be seen between High and Low Stakes, perhaps with modulation by question form. The difference will be apparent in the –FIN condition, where Stakes was manipulated. However, given the long-standing assumption that MA, but not MS, is available to every question, extant theories might predict that MA is trivially available. If so, MA Answer Types should receive high acceptance across-the-board, and the influence of Stakes will only be seen with MS Answer Types. Modal theories would predict that non-exhaustive (MS/MO) answers would receive high acceptance only in the –FIN condition, perhaps regardless of the context.

Regarding the manipulation of answer Informativity, we expect MAX-informative MS/MO answers to be more acceptable than MIN-Informative ones, because by design maximally-informative answers are better question resolvers than minimally-informative ones. This prediction is in line with underspecification theories, which explicitly argue that question interpretation is driven by issues surrounding the resolution of the questioner's goals (see Ginzburg, 1995a; Asher and Lascarides, 1998; van Rooij, 2003). While this result could also be consistent with other theories, they offer no explicit account of how such effects arise.

4.3. Results

Experiment 2 results are in Figure 3. MO-MAX answers are more acceptable than MA answers in Low-Stakes scenarios (-FIN: $X^2(1) = 21.56$, $p<0.0001$; +FIN: $X^2(1) = 17.56$, $p<0.0001$). In the -FIN condition, there was a further Stakes x Answer Type (MA/MO-MAX) Interaction ($X^2(3) = 60.35$, $p<0.0001$) reflecting the fact that MO-MAX is more acceptable in Low- vs. High-Stakes, and MA responses are more acceptable than MO in High-Stakes. The effect of Stakes disappears in MS Answer Types (MIN v. MAX). Finally, Informativity significantly affected acceptability of an MS/MO answer: MIN answers were chosen significantly less than MAX (+FIN: $X^2(1) = 55.98$, $p<0.0001$; -FIN: $X^2(1) = 93.93$, $p<0.0001$).

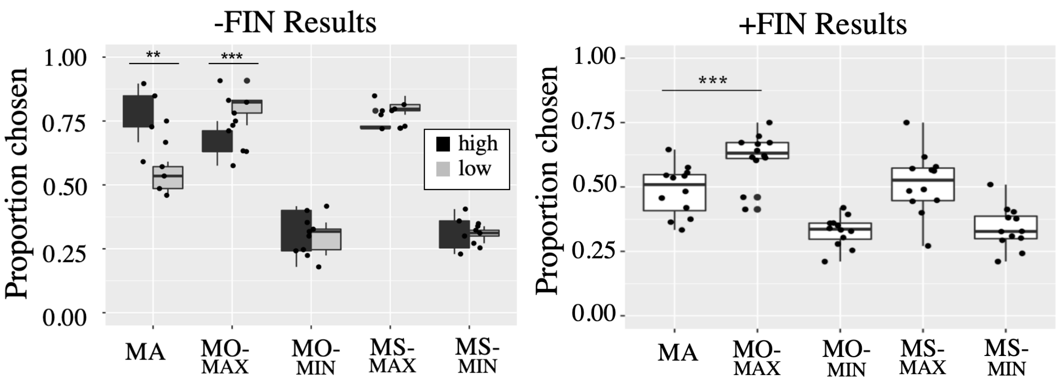

Figure 3: Experiment 2 Results.

4.4. Discussion

The results reveal the following. In the –FIN condition (left graph), MA answers were preferred over MS and MO answers in High Stakes contexts, with the exception of MS-MAX answers. Participants accepted both MA and MS-MAX answers at comparable levels in High Stakes contexts. By contrast, in the Low Stakes –FIN condition, MS-MAX and MO-MAX answers were preferred over MA answers. In the +FIN condition, MA answers did not consistently win out: here, too, participants were willing to accept a maximally informative MS or MO answer.

Thus, accounts that incorporate a role of pragmatics and contextually-relevant goals are best able to explain these patterns of results, while accounts that rigidly appeal to particular semantic or structural features as licensing answerhood type fall short. Still, the proportion of accepting non-exhaustive and maximally informative MO and MS answers was higher in the –FIN condition than in the +FIN condition, suggesting that a weaker modal account has explanatory power. Such a theory could say, consistent with our data, that the presence of a modal boosts the acceptability of non-exhaustive readings, while the absence of one does not block them.

That participants were sensitive to the Informativity of MS and MO answers (with maximally informative answers being more acceptable than minimally informative ones) is consistent with underspecification and ambiguity theories. In both types of accounts, context plays the crucial role of disambiguating, in the case of ambiguity, or of precisifying the relevant value(s) of the underspecified logical form. Whatever mechanism(s) are involved in this process, more information about the behavioral signatures of precisification and disambiguation would be incredibly illuminating.

These findings therefore demonstrate that the discourse context provides central information that is relevant to resolving a given question, including which answers are most informative and how much information is needed to resolve exhaustivity and the questioner's goal. This effect of context was observed *regardless* of finiteness in the embedded clause, and therefore did not depend on the presence of a modal element to license either an MO or MS answer. Finally, our results show no signs that a partially exhaustive non-singleton answer that is maximally informative is significantly degraded. This result held even when participants could perform an explicit comparison between MS and MO answers. If such MS answers can signal ignorance, our empirical results show that they do not consistently and obligatorily do so.

5. Conclusion

Across two experiments, we have presented empirical data that reveal the following. First, MS answers are not as constrained as has been previously assumed. They are acceptable when associated with either infinitival embedded questions or with finite embedded questions. The presence of a modal element facilitates licensing of a non-exhaustive answer, but is not a necessary precondition for it. Second, the type of embedding verb plays a role in answer acceptability, highlighting the role of lexical semantics. Third, pragmatics in the form of contextual information and a questioner's goals in the discourse context play a key role in the resolution of exhaustivity in a question. Finally, the type of mention-some answer matters: those that are more informative are valued more than those that are not. Thus, in this work, we have identified a set of surface-level and contextual cues that the speaker can manipulate and that the listener can recruit to arrive at an intended interpretation.

While these findings may make sense intuitively, our experiments are the first, we believe, to systematically probe the surface-level linguistic and discourse-level contextual cues that influence question-answer dynamics, and that they therefore are valuable to any theory of question semantics and pragmatics that seeks to identify what licenses or constrains answers to a given question. While both ambiguity and underspecification theories allow for wide availability of MS, ambiguity theories give no explicit account of contextual modulation, nor how certain questions encode stronger preferences for particular interpretations. At the same time, current modal-based theories and pragmatic theories that assume exhaustivity by default with optional weakening undergenerate MS. Our results highlight specific factors that license and constrain non-exhaustive answers, and thus prompt current theories to take seriously the form and context of the question-answer exchange, and the central role of the speaker and hearer.

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Distributivity over pairs of events and entities[1]

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Abstract. This paper aims to offer a formal semantic account of distributivity as introduced by prepositions *per* in Italian and *de* in Romanian. These prepositions occur in the configuration [Card N1 Prep N2] (where Card conveys cardinality and N2 is obligatorily a sortal noun), and are specialised in introducing a type of distributive configuration called ratio hereafter. It is shown that the *per/de* configuration shares properties with phenomena analysed in two separate lines of investigation in the literature, one concerned mainly with nominal distributivity, and the other with relations between events. Like nominal distributive markers, *per/de* signals an obligatorily distributive interpretation of the DP it is a part of. Like 'every time' sentences, the *per/de* construction involves a distributive relation between key events and share events. It is proposed that *per/de* introduces distributivity by the selection and matching of a share nominal and an overt or covert key event. Distributivity is formalised via a matching function that resorts to a (possibly overt) universal quantifiers over event-entity pairs.

Keywords: distributivity, ratio, matching function.

1. Introduction

1.1. Marking distributivity

Italian and Romanian exhibit a particular distributive configuration featuring a nominal phrase containing preposition *per* and *de* respectively. In order to appreciate the peculiarity of this configuration, it is useful to recall that two types of distributive configurations are widely attested across languages, see the entry on distributive numerals (Gil, 2005) in the WALS. One option is to mark distributively the sorting key in the standard terminology by (Choe, 1987), the other is to overtly mark the distributed share. Italian marks distributivity on the key and allows quantifier floating, like English and French among various Western European languages, and like other languages, see (Safir and Stowell, 1988; Junker, 1995; Zimmermann, 2002; Bobalijk, 2002; Champollion, 2017) among many scholars.

(1) a. Hanno preso tre pesci ciascuno. (Italian)
have.3PL caught three fish each
'They caught three fish each.'

b. Ils ont attrapé trois poissons chacun. (French)
they have caught three fish each
'They caught three fish each.'

The second strategy (marking distributivity on the share) is present in Romanian (2a), Albanian, various other East European languages, and many other languages, see the Tlingit example (2b) from (Cable, 2014) and work by Choe (1987); Gil (1988); Oh (2006); Henderson (2012, 2014); Farkas (2015) and many other scholars.

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(2) a. Au prins câte trei peşti. (Romanian)
have.3PL caught DIST three fish
'They caught three fish each.'

b. Nás'gigáa xáat has aawasháat (Tlingit)
three.DIST fish 3plS.3O.caught
'They caught three fish each.'

Expressions of ratio in Italian and Romanian [2] seem to offer a point of convergence between the two strategies. Both languages use a similar configuration in order to express ratios, where a preposition marks the key. This is also the case for English, French (Tovena, 2016) and various other languages. Italian uses preposition *per* and Romanian uses preposition *de*, in a construction that can be schematised as [Card N1 Prep N2], where N2 is a sortal noun, Card conveys cardinality and N1 is a noun.

(3) a. James Bond a mâncat două măsline de martini. (Romanian)
James Bond has eaten two olives DE martini
'James Bond ate two olives per martini.'

b. James Bond ha mangiato due olive per martini. (Italian)
James Bond has eaten two olives PER martini
'James Bond ate two olives per martini.'

c. James Bond ate two olives per martini.

The interpretation of the examples in (3) is that for each martini that James Bond drank, there were two olives that he ate, i.e. the preposition enforces a distributive interpretation.

1.2. Forms of distribution

Preposition *per/de* is a share-key relator, where the share is N1, the key is N2, the relation N1:N2 is best described as a ratio, and the key (N2) provides the unit (the ratio of olives to martinis is 2 to 1). Importantly, a closer look at the distribution of these constructions in the two languages reveals that certain semantic and pragmatic constraints are involved, to the effect that not all contexts in which it is acceptable to say that the ratio of N1s to N2s is n to m, is the *per/de* construction an acceptable paraphrase. To anticipate, we will claim that N2 is constrained to be interpreted as participant in some event distinct from the main clause event (eating in (3)), an event that may be either overt or covert (presumably a drinking event in (3)). A first key remark concerns the pluralities of events that are built.

What is interesting about these constructions as opposed to the two types of strategies of marking nominal distributivity, on the key and on the share, mentioned above in (1) and (2), is that *per/de* seems to relate the share and the key within the same DP, which makes it a very local configuration. At the same time, the share and key must be participants in distinct events. Thus, ratio expressions, cf. (3), are instances of distributive configurations that stand out because, as just said, they have a sorting key that is not part of the argument structure of the clause hosting

[2] This term is understood more generally to apply to an ordered pair of numbers that expresses a multiplicative comparison of quantities.

it. Key and share do not belong to the same argument structure, which brings the construction closer to biclausal distributive phenomena such as *every time* sentences.

Carrying out the task of analysing ratio expressions provides a promising starting point for establishing a connection between two theoretical strands in the literature on distributivity, one concerned mainly with nominal distributivity and illustrated by the preceding examples as well as by the English example in (4c), and the other concerned mainly with inter-sentential phenomena and illustrated by the English sentences in (4a) and (4b).

(4) a. Every time I go to the bakery, I meet a friend.
    b. For every rain drop that falls, a flower grows.
    c. They caught three fish each.

Let's take a comparative look at *per* in (3) and *every time/drop* in (4a,b). The interpretation of the Italian and Romanian sentences with *per/de* in (3) above resembles the interpretation of (4a) in that the events of meeting a friend are matched onto events of going to the bakery and, correspondingly, the events of drinking a martini are matched onto events of eating two olives. It is similar to the interpretation of (4b) in that the growing of a flower events are matched onto raindrop falling events, parallel to the martinis being matched to eating two olives.

One difference between (3) and (4a,b) is that the latter are biclausal. Moreover, in the former example, the description of the events of drinking is covert (when it is overt, it is expressed as participles or other deverbal adjectives denoting non-stative eventualities). A third difference is that in (3), but not in (4a,b), there is a relevant key entity which is obligatorily distributed. This is the key entity introduced by the preposition. In the 'every time' sentence, one finds no such entity, that is, *a friend* is not prevented from getting a wide scope interpretation. In (4b), the key is a nominal and the share is eventive, which is the opposite of the constructions discussed here.

Let's now turn to broadly comparing *per* in (3) and other distributive markers, illustrated with binominal *each* in (4c). Sentence (3) resembles (4c) in that the latter constrains the interpretation to associate each agent of catching onto themes of catching of cardinality three, within some subevent, so that more than three fish are caught overall. Likewise, each martini is associated with two olives. A difference between these two cases is that in (3) the martinis are not participants in the main clause events of eating, while in (4c) there is only one event description over all, a catching type of event, that is multiply instantiated and where key and share entities (*they* and *fish*) are co-participants.

In short, on the one hand, *per/de* signals an obligatorily distributive interpretation of the DP it is a part of, like nominal distributive markers as in (4c). On the other hand, *per/de* constructions involve a distributive relation between key events and share events, i.e. the share and key entities are not participants in the same events, like 'every time' sentences and Boolos sentences illustrated in (4a,b). The gist of our analysis is that *per/de* introduces distributivity by the selection and matching of a share nominal and an overt or covert key event.

The remainder of the paper is organised as follow. Some of the properties of the prepositions *per* for Italian and *de* for Romanian in their distributive uses are reviewed in section 2. These uses appear to be more constrained than with specialised counterpart prepositions such as English *per* and German *pro*, relatively to the noun that can restrict the key, and the availability of the key event. Then, we turn to 'every time' sentences and event-related readings. Section 3 opens with a quick review of some similarities between these biclausal sentences and the distributive configuration at hand, and we recall the analyses proposed in the literature, which rely on matching functions. In all these cases, a matching function denotes sets of pairs of events. On the contrary, sentences of the 'Ships passing through the lock' type, have been claimed optionally to involve universal quantification over event-objects pairs. We look at them in section 4, where we collect elements that contribute to our proposal that is presented in section 5. We assume that the prepositions *per/de* in configuration [Card N1 *per/de* N2] syntactically combines with the distributive key (N2), but semantically it relates a plurality of key events—each each having an atomic key participant—to a plurality of share entities. As a matter of fact, the preposition sets up a match, but the matching elements do not have the same semantic type. The events associated with each of the shares are introduced somewhere else in the clause, depending on the position of the constituent expressing the share. Finally, section 6 concludes the paper.

2. The distribution of *per/de*

As mentioned in the introduction, the Italian and Romanian ratio constructions display a narrower distribution as opposed to sentences of the type *The ratio of N1s to N2s is n to m.* The same contrast is observed if we compare It./Rom. *per/de* to English *per* and German *pro*. Firstly, it should be possible to instantiate N2 with a measure expression in principle, and this is the case in German (5) and the English translations. However, in Italian and Romanian, *per/de* cannot be used if N2 is a measure noun. The two languages employ a distinct preposition or no preposition when N2 is a measure, as illustrated in (6).

(5) a. drei Mahlzeiten pro Tag
three meals per day
'three meals per day'

b. zehn Ziegel pro Quadratmeter
ten tiles per square=meter
'ten tiles per square meter'

c. fünfzig Kilometer pro Stunde
fifty kilometer per hour
'fifty kilometers per hour' (German)

(6) a. John earns 20 euros per hour.

b. Gianni guadagna 20 euro l'ora. (Italian)
Gianni earns 20 euros the=hour
'Gianni earns 20 euros per hour.'

c. Ion câştigă 20 de euro pe oră. (Romanian)
Ion earns 20 of euros PE hour
'Ion earns 20 euros per hour.'

Second, even when N2 is a sortal noun, the constructions of the form [Card N1 Prep N2] are not acceptable in all the cases[3] where the corresponding English/ German constructions with *per/pro* are acceptable. An overt universal quantifier has to be used in these cases. Conversely, adding *every* in the English construction produces an ungrammatical result, see (7).

(7) a. [We are going to prepare the reception hall.]
We'll put **three wine bottles per (*every) table**.

b. [Vom decora sala de festivităţi.]
Vom pune **trei sticle de vin de ??(fiecare) masă**. (Romanian)
will put three bottles of wine DE every table

c. [Prepariamo la sala del ricevimento.]
Metteremo **tre bottiglie di vino per ?(?ogni) tavolo**. (Italian)
put.FUT three bottles of wine PER every table

In the sentences in (7), the spatial connection between the tables and the bottles of wine that are to be placed on them is not enough to legitimate the distributive relation in the absence of the universal quantifier. Moreover, (7) does not support a part-whole relation as in (8).

(8) a. In this school, there are **twenty students per (*every) class**.

b. In questa scuola, ci sono **venti studenti per ??(ogni) classe**. (Italian)
In this school, there are twenty students PER every class

c. În această şcoală sunt **douăzeci de studenţi de ??(fiecare)** clasă. (Romanian)
In this school are twenty of students DE every class

The only cases where *per/de* can be followed by a bare noun are those where this noun is associated with some non-stative eventuality, one that is different from the eventuality description provided by the main verb. The associated event can be retrieved in two ways: it is either mentioned in previous discourse/ part of the common ground or provided overtly in cases where N2 itself is event-denoting or otherwise via the modification of a participial adjective.

(9) a. The restaurant will provide two coffees per customer for free.

b. Il ristorante offre gratuitamente due caffè per avventore. (Italian)
the restaurant offers for free two coffee PER patron
'The restaurant will provide two coffees per customer for free.'

c. Restaurantul va oferi două cafele de client pe gratis. (Romanian)
restaurant.DEF will offer two coffee DE patron at for free
'The restaurant will provide two coffees per customer for free.'

Let's look at the following Romanian example involving an event-denoting adjective:

(10) Funcţionarul a înregistrat două plângeri de telefon $^{??}$(pierdut). (Romanian)
clerk.DEF has filed two complaints DE telephone lost
'The clerk filed two complaints per lost phone.'

[3]An issue that interferes is related to subcategorisation requirements. It does not sound natural to introduce with *per* the location in sentence with a three valency verb such as *mettere* in Italian.

If it is not made explicit in the context that we are talking about phones which have been lost, the construction with bare N2 is degraded. Adding *fiecare* ('every') rescues the construction, but, importantly, note that so does adding an eventive participial adjective as *pierdut* ('lost') in *de telefon pierdut* ('per lost phone').

Another remark, which applies to all of the examples provided so far, is that if the modifier is stative, adding it to the construction does not improve its acceptability, see the Romanian example in (11) and the Italian (12).

(11) ??Grădina zoologică are un surplus de o sută de vizitatori de specie neobişnuită. (Romanian)
Garden.DEF zoological has a surplus of one hundred of visitors DE species uncommon
'The zoo has an extra one hundred visitors per uncommon species.'

(12) ??Lo zoo ha ricevuto mille euro per animale morto (Italian)
DEF zzo has got thousant euros PER animal dead
'The zoo received one thousand euros per dead animal.'

3. 'Every time' sentences and the matching function

We have seen in the previous section that the construction with a bare N2, i.e. [Card N1 *per/de* N2], is sensitive to the retrieval of an event associated with the sorting key (N2), while the construction with a universal distributive quantifier, i.e. [Card N1 *per/de* UnivQuant N2], is not. To anticipate, the proposal in the following section will rest on the assumption that the construction with *per/de* and a bare N2 involves a covert event-related universal operator. The properties of the universal operator are presented in section 4. Also, the preposition introduces a matching function which relates the share nominal N1 (a participant in the main clause eventuality) to the key event (which is either overt or implicit, and which has N2 as a participant). In what follows, we will refer to the treatment of every time sentences in Rothstein (1995). The matching function will be one of the ingredients in the analysis of *per/de* constructions, which is laid out in section 5.

A relevant property of this construction is that there is a unique mapping between the key event (and its N2 participant) and the share nominal N1. This is necessarily the case for (3) because of the fact that drinking events are non-iterative, one-time events. Thus, in order to highlight the effect, we will look at iterable events as in (10) above instead. In the case of (10), it may be that the same phone is lost more than once, which means the ratio of complaints to phones is more than 2:1. Imagine that there is only one phone which was lost twice. Then there will be four complaints matching only one phone (4:1). This is a case of recycling individuals, as labeled by Krifka (1990). But, necessarily, the losing events have to be distinct from one another, so that the ratio of complaints to 'losings' is indeed 2:1. The same requirement was argued for in 'every time' sentences by Rothstein (1995), Landman (2004), as well as 'for every' sentences by Boolos (1981), see (13) and (14).

(13) Every time the bell rings, Mary opens the door. (=(4a))

(14) For every drop of rain that falls, a flower grows. (=(4b))

The two sentences above were argued to involve matching functions by Rothstein (1995), a claim that is based on the contrast with universal quantification in the nominal domain. Consider the simple example in (15a) and the formal representation she proposes in (15b).

(15) a. Every girl saw a film.
b. $\forall$x [GIRL(x)$\rightarrow$ $\exists$e [SEE(e) $\wedge$ Agent(e) = x $\wedge$ $\exists$(y)[FILM(y) $\wedge$ Theme(e) = y]]]

As Rothstein remarks, the formalisation (correctly) allows for the recycling of films, i.e. the same film may have been watched by two distinct girls on different occasions. By contrast, (13) and (14) above do not permit the situation where two ringing events are matched to the same door-opening and two raindrops are matched to the same flower-growing. This restriction is captured formally by Boolos by using the matching function noted F in his representation (16), and by Rothstein using the matching function noted M in her representation (17).

(16) a. For every drop of rain that falls, a flower grows.
b. $\forall$x [DROP-THAT-FALLS(x) $\rightarrow$ $\exists$e [GROW(e) $\wedge$ $\exists$y [FLOWER(y) $\wedge$ Theme(e) = y $\wedge$ F(e) = x]]]

(17) a. Every time the bell rings, Mary opens the door.
b. $\forall$e [RING(e) $\wedge$ Theme(e) = the-bell $\rightarrow$ $\exists$e' [OPEN(e') $\wedge$ Agent(e') = Mary $\wedge$ Theme(e') = the-door $\wedge$ M(e') = e]]

This type of function is a surjection, with the main clause constituent (OPEN(e') and GROW(e) in (17) and (16) respectively) corresponding to the domain of the function and the constituent introduced by *every* corresponding to the co-domain (RING(e) and DROP-THAT-FALLS(x) respectively). This allows for there to be two or more door-openings after only one bell-ringing, but requires at least one door-opening matched to each bell-ringing. By the same reasoning, the F function allows for there to be two or more flowers that grow, but necessarily no raindrop falls without at least one flower growing.

In a similar fashion, we will propose that *per/de* constructions schematised as [Card N1 *per/de* N2] introduce a matching function of the type match(N1) = e2, where e2 is the event that the key nominal is a participant in. For instance, in (10), the matching function will be **match (x) = e**, where x is an entity type variable that ranges over share entities (e.g. complaints) and e is an event type variable that ranges over key events (e.g. losing events, with phones as themes). This is the opposite of the Boolos sentence in (14), where the domain consisted of events and the co-domain of entities.

4. 'Ships passing through the lock' event-related readings

Doetjes and Honcoop (1997) refine the analysis of Krifka (1990) of sentences such as (18) below, which has two distinguishable readings: one in which we strictly count objects (ships) and one in which we count ship-passing events.

(18) Last year, four thousand ships passed through the lock.

Thus, the same state of affairs—in which, for example, there were 4000 ships and they passed through the lock twice, making it 8000 passings—may be truthfully expressed in two ways: *4000 ships passed through the lock* (object-related or OR reading) and *8000 ships passed through the lock* (event-related or ER reading). The event-related reading is presumably an option which all determiners have (under certain conditions). Doetjes and Honcoop (1997) show how strong quantifiers such as *every* can get an event-related reading only if they have an event in the restriction. These determiners always have an alternative default version where they bind only an entity variable, in which case they get the object-related reading. His example is with *most*, but the same is true of *every* or any other strong quantifier.

(19) Last year, most ships passed through the lock.
  a. object-related:
     most ships are such that each of them passed through the lock last year.
  b. event-related:
     *most events in which a ship passed through the lock (last year) occurred last year.

(20) Most ships that passed through the lock transported radioactive waste.
  a. object-related:
     most ships that passed through the lock are such that each transported radioactive waste.
  b. event-related:
     most events in which a ship passed through the lock were events in which a ship transported radioactive waste.

Doetjes and Honcoop (1997) claim that the quantifier comes by default with a version in which it binds an entity type variable x and optionally, if there is an event in the restrictor as in (20), the quantifier can bind an event-object pair of variables $\langle$e,x$\rangle$, where e is an event-type variable and x is an entity-type variable. This is relevant for the distributive configuration under discussion in this paper. We suggest that *per/de* selects a DP headed by a silent universal which obligatorily ranges over event-object pairs.

Doetjes and Honcoop (1997) do not talk about any matching function in the case of event-related readings, but they do mention some restrictions (which only apply to event-related readings) on the events in the restrictor, namely that the restrictor event has to precede the main clause event or be somehow causally connected to it. In our case, the matching function would be responsible for the requirement that there should be an (indirect) connection between key and share events.

As a consequence, we assume that *per/de* can introduce a DP headed by an overt *every*, which ranges over entity type $\langle$x$\rangle$ variables or optionally also over event-entity pairs $\langle$e,x$\rangle$ as below. We follow Doetjes and Honcoop (1997) in noting the type of the variable on the universal quantifier.

(21) a. per ogni classe/ de fiecare clasă (per every class)
  b. Card N1 PER/DE OGNI,FIECARE$_{\langle x\rangle/\langle e,x\rangle}$ N2

Conversely, *per/de* can head a silent universal operator with a more restricted distribution, ranging only over event-entity pairs of variables ⟨e,x⟩, as below:

(22) a. per classe/ de clasă ('per every class')
b. Card N1 PER/DE ($\forall_{\langle e,x \rangle}$) N2

The following section spells out the details of the analysis.

5. The proposal: a silent event-related universal operator and a matching function

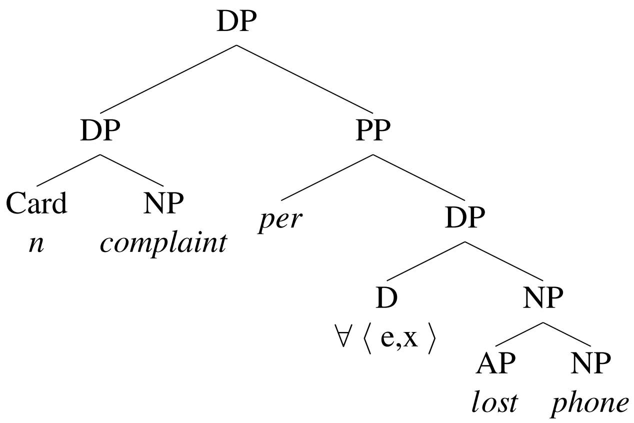
Let's take (23) as an illustration of the ratio configuration [Card N1 *per/de* N2]. We assume that syntactically *per/de* combines with the distributive key (N2), but semantically it relates a plurality of key events (losing in (23)), each having an atomic key participant (phone), to a plurality of share entities (complaints).

(23) Funcţionarul a înregistrat două plângeri de telefon pierdut.
Clerk-DEF has filed two complaints DE telephone lost
(Romanian)

'The clerk filed two complaints per lost telephone.'

The telephone-losing events are the key. The variables that are picked out by the matching function are the key events (losing) and the share participants (complaints, which are the theme of the filing events). We assume that the *per/de* phrase is a modifier of the share DP, and the key event variable is a modifier of the key noun phrase (typically a participial adjective, as in the examples concerning lost phones). Even in cases in which no modifier is present we assume that the key NP is either eventive itself (e.g. *per participant*, or has a covert eventive modifier, e.g. in the case of (3), *(DRUNK) martini*. In any case, an event variable is required on the sorting key in order to meet the selectional specifications of the preposition. The structure for (23) is as provided in (24) where the share is a full DP before it combines with *per/de*.

(24)



(25) a. [[telephone]] = λr [telephone(r)]
b. [[lost]] = λzλe'[losing(e') $\wedge$ Theme(e') = z]

The event description is a modifier of the key noun phrase. The entries in (25) combine by predicate modification.

(26) [[lost telephone]] = $\lambda z \lambda e'$[losing(e') $\wedge$ Theme(e') = z $\wedge$ telephone(z)]

In words, *lost telephones* is interpreted as the set of entities in the denotation of the predicate 'telephone' each of which is a participant in an event e'.

The entry for *per/de* is provided in (27).

(27) [[per]] = $\lambda P_{<e,vt>} \lambda x \lambda e \lambda Q \lambda n$ [$\forall\langle$ e,x $\rangle$ [P(e,x) $\rightarrow$
[$\exists$y Q(y) $\wedge$ |y|=n $\wedge$ match(y) = e]]]

Per/de selects a complex predicate of events and entities P, as well as the entity and event variables x and e. This is the sortal key constituent. The share constituent is represented above as a nominal property Q and a cardinal n. The preposition then relates the key and the share via the universal operator, such that for every phone that is part of a complex predicate P (lost phone), there is a y which is in the extension of property Q (complaint) such that y has cardinality and the matching function applies to y (two complaints), returning the value e (the losing event).

6. Conclusion

The prepositions *per* for Italian and *de* for Romanian we have looked at, in their distributive interpretation in the configuration [Card N1 *per/de* N2], albeit extremely restrictive in their distribution, are of theoretical import because they display not only a local form of distributivity (a share-key dependency within the nominal domain), but also a local interdependence between events and nominal participants. As such, the configuration brings together properties which have been addressed separately, in distinct constructions, on the one hand in the literature on nominal distributivity, and on the other hand in works focusing on event plurality and distributivity.

We have outlined an account that brings together reflections produced in both lines of study, and appeals to options exploited in both directions of investigation. This account of *per/de* constructions is to be included among the proposals which posit a very close-knit relation between nominal phrases and events/situations. To name just a few, let us recall the quantificational variability effects on definite DPs, e.g. see Hinterwimmer (2008), situational pronouns on the universal quantifier *every*, e.g. see Kratzer (2004), and on definite determiner, e.g. see Schwarz (2009).

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A semantic underspecification-based analysis of scope ambiguities in gapping[1]

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Abstract. Gapping is known to interact with scopal operators to create an ambiguity between so-called wide- and distributive-scope readings (Siegel, 1984). In this paper, we offer an analysis of these readings which combines an underspecified treatment of scope and a general theory of coordination. Utilizing the technique of semantic underspecification (Richter and Sailer, 2004), we develop a new coordination rule that captures an asymmetry in the semantic contributions between initial and non-initial conjuncts observed independently of Gapping. This semantic asymmetry in coordination as well as well-justified assumptions about tense and scopal operators (Condoravdi, 2002; Champollion, 2015) correctly predict the various readings of conjoined sentences with or without Gapping.

Keywords: Gapping, coordination, scope, semantic underspecification, Lexical Resource Semantics.

1. Introduction

Gapping is an ellipsis construction characterized by the obligatory absence of a finite verb, as shown in (1a), but other material may go missing, too, as shown in (1b).

(1) a. Fred ordered coffee and Mary tea.
    b. Kim wanted to try to write a novel and Tim a song.

One basic issue raised by Gapping is that the strings that are coordinated do not seem to have equal status; instead, we seem to be coordinating a full clause with a sequence of unconnected constituents. This presents a problem to one of the basic assumptions in syntax/semantics: coordination combines constituents of like category and semantic type.

A more difficult challenge is posed by scopal interactions between Gapping and operators such as negation and modals (Siegel, 1984, 1987). This is exemplified by (2), where a lexical verb as well as, potentially, a finite auxiliary are missing from the second conjunct. The challenge is to explain the availability of two different readings: (2) has a *distributive-scope reading* (henceforth, DSR) in which the negated modal contributed by the auxiliary is part of each conjunct's interpretation (see (2a)). But this sentence also has a *wide-scope reading* (henceforth WSR) in which the negated modal outscopes the conjunction (see (2b)).

(2) John can't live in Barcelona and Mary in New York.
    a. Distributive-scope reading: $\neg\Diamond$[live-in(j,brc)]$\wedge\neg\Diamond$[live-in(m,ny)]
       (Paraphrase: It is impossible for John to live in Barcelona – e.g. because he can't stand traffic jams – and it is impossible for Mary to live in New York – e.g. because she hates cold winters.)

[1]We would like to thank Hanno Beck, Jonathan Ginzburg, Kyle Johnson, and the audiences at Sinn und Bedeutung 23 and HPSG 25. All errors and shortcomings are our own.

b. Wide-scope reading: $\neg\Diamond$[live-in(j,brc)$\wedge$live-in(m,ny)]
(Paraphrase: What's impossible is for John to live in Barcelona and Mary to live in New York – e.g. because they can't be apart from each other.)

Assuming that the missing material in Gapping stands for a copy of its antecedent, the availability of (2a) is expected. The problem is (2b): since scopal operators contributed by auxiliaries do not usually take scope beyond their local clauses, the wide-scope of *can't* is unexpected. So, how does Gapping allow for readings (WSRs) that are otherwise unavailable?

In this paper, we propose an analysis which takes advantage of semantic underspecification techniques (Reyle, 1993; Egg et al., 2001; Richter and Sailer, 2004; Copestake et al., 2005) while using independently motivated type-theoretic semantics for tense and scopal operators (Condoravdi, 2002; Champollion, 2015). Our key analytic intuition is to consider the two readings of (2) as different denotations of a *single*, *underspecified* description, a view we share with previous semantic underspecification-based approaches to scope ambiguity. Since ellipsis is known to be a potential source of scope ambiguity (Shieber et al., 1996), a treatment in terms of semantic underspecification is attractive. We suggest that the scope ambiguity in (2) hinges on two processes: (i) (semantic) recovery of the gapped material and (ii) specification of the semantic type of conjunction. The two possible scopal relations in (2) follow from these processes. In a way this can be seen as equivalent to an analysis that appeals to a syntactic ambiguity between vP- and CP-domain coordination (Potter et al., 2017), but there is a critical conceptual difference. In our analysis there is *no* grammatical ambiguity in Gapping sentences: the various readings of a Gapping sentence are instead modeled with a single set of constraints which correspond to (i.e., formally denote) two distinct fully specified representations in the logical language.

The paper is structured as follows. In Section 2 we present data to support the empirical claim that WSR is not a general property of Gapping but rather limited to cases in which Gapping occurs in coordinate structures. Previous accounts are discussed in Section 3. Section 4 contains an informal sketch of our analysis of Gapping and the DSR/WSR ambiguity, as well as an independently motivated coordination rule that captures these readings. The analysis is recast in Lexical Resource Semantics in Section 5. Finally, Section 6 summarizes and concludes the paper.

2. Data on the DSR/WSR ambiguity

We begin by establishing the basic descriptive generalizations regarding the DSR/WSR ambiguity. As Siegel (1984, 1987), Potter et al. (2017) and others have noted, the DSR/WSR ambiguity is not correlated with a particular modality and can occur with or without negation. The sentence in (3) exemplifies disjunctive Gapping with the deontic modal *must*, with its DSR and WSR provided in (3a) and (3b).

(3) Leslie must eat the spinach or Robin the broccoli.

a. DSR = $\Box$[eat(l,s)]$\vee\Box$[eat(r,b)]
Leslie and Robin are under independent obligations, but we are not sure which one is the case: Leslie must eat the spinach or Robin must eat the broccoli.

b. WSR = $\Box$[eat(l,s)$\vee$eat(r,b)]
What must happen is: Leslie eat the spinach or Robin eat the broccoli.

Auxiliaries are not the only elements that participate in the DSR/WSR ambiguity. Adverbs induce the same kind of ambiguity:

(4) Kim often reads newspapers and Sue magazines.
  a. DSR = *often*[read(k,n)]∧*often*[read(s,m)]
  Kim often reads newspapers and Sue often reads magazines (but not necessarily at the same time).
  b. WSR = *often*[read(k,n)∧read(s,m)]
  Often, Kim reads newspapers and Sue reads magazines.

Crucially, the WSRs of (2)-(4) are unavailable if Gapping does not occur. Compare for instance (3) and (4) with (5a) and (5b) below.

(5) a. Leslie must eat the spinach or Robin must eat the broccoli.
  b. Kim often reads newspapers and Sue (often) reads magazines.

However, although Gapping is a necessary condition for the DSR/WSR ambiguity, it does not seem to be a sufficient condition. Culicover and Jackendoff (2005) note that Gapping is not limited to coordinate structures; see (6), for example.

(6) Robin speaks French, not to mention Leslie German.
(Culicover and Jackendoff, 2005: 278)

But, sentences such as (6) do not induce the same kind of scopal interactions observed in Gapping with Boolean connectives we illustrated above. Sentence (7) does not have an auxiliary wide-scope reading, i.e. ‘It is not the case that [Robin speaks French, not to mention Leslie German]’.

(7) Robin doesn’t speak French, not to mention Leslie German.

In the case of comparative structures, such as (8), an apparent wide-scope reading is available: (8) has a reading in which the auxiliary *can’t* outscopes *better than*. But note that this reading is available without Gapping: cf. *Robin can’t speak French better than Leslie speaks German.*

(8) Robin can’t speak French better than Leslie German.

This suggests that there are two independent mechanisms involved in the licensing of DSR vs. WSR readings: Gapping (which is responsible for the absence of a tensed element) and coordination (see Section 4).

3. Previous analyses: The DSR/WSR ambiguity as a *syntactic* ambiguity

In this section we briefly discuss previous proposals for the DSR/WSR ambiguity. We will consider syntactic transformational analyses (Section 3.1) and a Type-Logical Categorial Grammar analysis (Section 3.2).

3.1. Syntactic transformational analyses

There are three main analyses of Gapping within the tradition of transformational syntax. The first is the ‘large coordination analysis’ that posits that Gapping sentences derive from coordination of full clauses and elision of redundant material (Ross, 1970; Sag, 1976; Jayaseelan, 1990; Hartmann, 2000, a.o.). In this analysis, (2) would be assigned a structure roughly equivalent to that of its ungapped counterpart. This leads to an obvious problem, however: since each conjunct contains its own auxiliary in this analysis, it can only predict DSRs.

Alternatively, one can assume that Gapping sentences involve a hidden, subsentential coordination, roughly at the vP-level ('small coordination analysis') (Coppock, 2001; Lin, 2002; Johnson, 2009; Toosarvandani, 2013). In this analysis, (2) would have a structure such as (9) at some stage in the derivation.

(9) [$_{\mathrm{T}}$ can't [$_{\mathrm{vP}}$ [$_{\mathrm{vP}}$ John live in Barcelona] and [$_{\mathrm{vP}}$ Mary live in New York]]

This structure involves a coordination below T, a position where the auxiliary is located. As one can expect, this analysis has the opposite problem: it only accounts for WSRs.

More recently, Potter (2014) and Potter et al. (2017) develop a hybrid analysis which combines the large and small coordination analyses ('two source analysis'). These authors characterize Gapping as a move-and-elide operation that applies precisely to two distinct syntactic structures: CP and vP coordination. Below, (10a) and (10b) show the two alternative parses for (2) in Potter et al.'s analysis (where strikethrough indicates nonpronunciation).

(10) a. Gapping in CP coordination (DSR):
[$_{\mathrm{CP}}$ John can't live in Barcelona] and [$_{\mathrm{CP}}$ Mary$_x$ [in New York]$_y$ ~~t_x can't live t_y~~]]
b. Gapping in vP coordination (WSR):
John$_j$ [$_{\mathrm{T}}$ can't [$_{\mathrm{vP}}$ [$_{\mathrm{vP}}$ t_j live in Barcelona] and [$_{\mathrm{vP}}$ Mary$_x$ [in New York]$_y$ ~~t_x live t_y~~]]]

Potter et al. assume that the availability of CP- and vP-domain Gapping follows from there being proper landing sites for the remnants (which are Topics or Foci) within these projections (Rizzi, 1997; Gengel, 2007): specifically, CP coordination Gapping involves topicalization to CP-Top while in vP coordination Gapping the remnants move to vP-Foc. This leads us to an interesting prediction: if Gapping applies to a structure where topicalization of the remnant is unavailable (i.e., if a CP coordination parse is unavailable), the DSR should be unavailable. Potter et al. (2017: 1142) observe that this prediction is borne out in (11). Note that in this example the left peripheral PP occupies CP-Top.

(11) [$_{\mathrm{CP}}$ With only ten dollars between them, [$_{\mathrm{TP}}$ James$_x$ could [$_{\mathrm{vP}}$ [$_{\mathrm{vP}}$ t_x get a sandwich] and [$_{\mathrm{vP}}$ Mary a bowl of soup]]]]

One possible objection to this account (which requires much closer examination than we can provide here) is that there are cases where the prediction is not borne out. For instance, it is known that topicalization has the effect of preventing *wh*-extraction (Lasnik and Saito, 1992; Boeckx and Jeong, 2004; Haegeman, 2012); see (12).[2]

[2]The matter is of course complicated by the fact that *wh*-relatives seem to tolerate topic 'island' violations:
(i) A university is the kind of place in which, that kind of behavior, we cannot tolerate. (Haegeman, 2012)
Moreover, topicalization across a *wh*-phrase seems possible in cases such as (ii).
(ii) ?This book, to whom should we give? (Pesetsky, 1982: 13, attributed to A. Watanabe)
However, given that many speakers unanimously find the examples in (12) to be unacceptable, we believe the variability in (i)-(ii) does not affect our claim here that the supposed topicalization of remnants cannot adequately predict the availability or absence of DSRs.

(12) a. *When did THIS BOOK everyone read?
b. *Who did you say that TO MARY John introduced?

If true, a CP coordination parse is ruled out for (13) according to Potter et al.'s analysis: the only possibility is one where *Bill* and *to Sue* have moved to vP internal positions for Foci.

(13) Who did you say that John introduced to Mary and Bill to Sue?

Potter et al. thus predict that, if a negation precedes the putative coordinated vP in (13), as in (14), the DSR should be unavailable. This prediction is not borne out: (14) readily admits a DSR, i.e. 'Who did you say that Bill wouldn't introduce to Sue and John wouldn't introduce to Mary?'

(14) Who did you say that Bill wouldn't introduce to Sue and John to Mary?

Furthermore, there are problems with the argument that vP coordination can be involved in gapped clauses in the first place. In their critique of the small coordination analysis, Kubota and Levine (2016: 122-5) provide empirical evidence that gapped conjuncts pattern as an S, not as a vP. Since Potter et al.'s analysis preserves the basic ideas of the small coordination analysis, essentially the same critique applies to it. Here, we repeat one of Kubota and Levine's arguments that is based on the distribution of *merely*. Given that *merely* is a vP modifier, it should be able to precede gapped clauses, if a vP coordination parse is available. This prediction is not borne out, as (15) shows:

(15) Robin didn't comment only that our margins were too small, and {Leslie merely/*merely Leslie} that our footnotes were too long.
(modified based on Kubota and Levine's (37))

Thus, recent transformational analyses (Potter, 2014; Potter et al., 2017), although capable of licensing both DSR and WSR readings, are based on problematic assumptions about the syntax of Gapping. Moreover, the connection purported to exist between the site of coordination and the availability of one reading or another does not seem to hold, which suggests that an account of DSR/WSR in terms of syntactic ambiguity is not on the right track.[3]

3.2. A Type-Logical Categorial Grammar analysis

Analyses of Gapping developed in Categorial Grammar provide treatments in terms of coordination of non-traditional constituents (Oehrle, 1987; Steedman, 2000; Kubota and Levine, 2012, 2016, a.o.). Here, we focus on the recent proposal in Kubota and Levine (2016).

Kubota and Levine offer an analysis in which the surface asymmetry in Gapping (i.e. coordination of a full clause with a string of remnants) and the DSR/WSR ambiguity result from two separate, simultaneous derivations at the semantic and prosodic levels. In this analysis, gapped clauses such as *John steak* are a sign of syntactic category S|((S\NP)/NP) (i.e. an S missing a transitive verb in the middle); the use of lambda binding at the prosodic level makes it possible to keep track of the position of the missing verb (see (16)).

(16) $\lambda\varphi.\mathsf{john}\circ\varphi\circ\mathsf{steak}$; $\lambda P.P(\mathrm{s})(\mathrm{j})$; $\mathrm{S}|((\mathrm{S}\backslash\mathrm{NP})/\mathrm{NP})$

[3]Potter et al. do not discuss cases such as (6)-(7), but it would be possible in principle to give such examples a treatment in terms of adjunction at the CP-level, which would explain the unavailability of WSRs.

Kubota and Levine assume the following Gapping-specific entry to coordinate signs such as (16) (ε stands for an empty string).

(17) $\lambda\sigma_2\lambda\sigma_1\lambda\varphi.[\sigma_1(\varphi)\circ\mathsf{and}\circ\sigma_2(\varepsilon)]$; $\lambda W\lambda V.V\sqcap W$; $(S|X)|(S|X)|(S|X)$

The derivation for the WSR of (e.g.) *John can't eat steak and Mary pizza* proceeds as follows. First, we conjoin *John steak* and *Mary pizza* via the entry in (17). Next, we create a TV constituent consisting of the lexical verb *eat* and a variable representing the auxiliary gap, using hypothetical reasoning (i.e. implication introduction). We then combine the resulting signs to obtain (18). Note that (17) ensures that the verb is pronounced only in the first conjunct.

(18) $\lambda\varphi_0.\mathsf{john}\circ\varphi_0\circ\mathsf{eat}\circ\mathsf{steak}\circ\mathsf{and}\circ\mathsf{mary}\circ\varepsilon\circ\mathsf{pizza}$; $\lambda f.[f(\text{eat}(s))(j)\wedge f(\text{eat}(p))(m)]$; $S|(VP/VP)$

Kubota and Levine postulate a special semantics for auxiliaries (i.e. they are propositional operators that take a proposition missing a predicate modifier as argument; see (19)). Thus, when the auxiliary *can't* composes with the sign in (18), the WSR is obtained.

(19)
$$\dfrac{\begin{array}{ll}\lambda\sigma_0.\sigma_0(\mathsf{can't}); & \lambda\varphi_0.\mathsf{john}\circ\varphi_0\circ\mathsf{eat}\circ\mathsf{steak}\circ\mathsf{and}\circ\mathsf{mary}\circ\varepsilon\circ\mathsf{pizza};\\ \lambda\mathscr{F}.\neg\Diamond\mathscr{F}(\mathsf{id}_{et}); S|(S|(VP/VP)) & \lambda f.[f(\text{eat(s)})(\text{j})\wedge f(\text{eat(p)})(\text{m})]; S|(VP/VP)\end{array}}{\mathsf{john}\circ\mathsf{can't}\circ\mathsf{eat}\circ\mathsf{steak}\circ\mathsf{and}\circ\mathsf{mary}\circ\varepsilon\circ\mathsf{pizza}; \neg\Diamond[\text{eat(s)(j)}\wedge\text{eat(p)(m)}]; S}|E$$

The derivation for the DSR involves an additional step: deriving a VP/VP entry from the higher-order entry in (19), which is then given as argument to coordinated clauses that contain gaps (for details, see Kubota and Levine (2016: 149-50)).

Despite its elegance, it is not clear how this analysis can differentiate in a principled manner between cases of Gapping that involve Boolean connectives and cases such as (6). In Kubota and Levine's analysis, the DSR/WSR ambiguity follows from (i) the ambiguity of modals and (ii) the mechanism that composes clauses that contain gaps (i.e., (17)). This seems to predict that WSRs should in principle be available whenever there is an auxiliary gap. But as we saw above, the WSR is not available in (7). Kubota and Levine's analysis does not seem to provide a motivated account as to why this is the case.

4. Our semantic account

4.1. The plot

We suggest that the DSR/WSR ambiguity of Gapping sentences corresponds to a conjoining of eventuality descriptions vs. tensed propositions as in Potter et al.'s analysis, but without positing a syntactic ambiguity. Conceptualizing the DSR/WSR ambiguity this way requires a flexible syntax-semantics interface that techniques of semantic underspecification afford us (Reyle, 1993; Egg et al., 2001; Richter and Sailer, 2004; Copestake et al., 2005). Instead of assuming that the two readings of (2) correspond to distinct syntactic parses, we propose that these readings are different *resolved* meanings of a *single*, *underspecified* meaning. Since this underspecified meaning can be linked to a uniform syntactic structure, the various readings of Gapping sentences can be accounted for without the need to posit syntactic ambiguity. This is one major advantage over previous syntactic analyses in which each different scopal reading requires a corresponding unique syntactic parse or derivation.

As our earlier discussion showed (see Section 3.2), strings consisting of gapping remnants (such as *Mary in New York*) behave as constituents of category S, rather than vP. We therefore assume that Gapping sentences involve clausal (S) coordination. The novelty of our proposal lies in our treatment of coordination. We assume that the semantics of coordination is underspecified: what is being conjoined can be a subterm of the semantics of the first conjunct, provided that the conjoined terms match in their semantic type. The DSR and WSR possibilities arise as the result of different ways of specifying these underspecified meanings: (i) the gapped clause denotes a tensed proposition (DSR), or (ii) it denotes an eventuality description (WSR). We lay out details of the proposal in the remainder of this paper.

Our analysis treats Gapping and coordination as independent phenomena which, when combined, create the ambiguity between DSRs and WSRs. By separating Gapping from coordination, our analysis can correctly predict the distribution of WSRs, while relegating the account for the unavailability of WSRs in cases such as (7) to construction-specific syntax/semantics principles.

For reasons of simplicity we assume that gapped clauses involve a WYSIWYG syntax (Sag et al., 1985; Culicover and Jackendoff, 2005; Abeillé et al., 2014) and that the missing content is recovered via the question under discussion (cf. Reich, 2007). Nothing crucial hinges on these choices, however. Our proposal could be recast in syntactic reductionist approaches to Gapping (e.g. the large coordination analysis) with elision of redundant material in tensed or untensed clauses, so long as the semantic treatment proposed here is preserved.

4.2. A type-driven account for DSR/WSR

We assume a type-logical distinction between eventuality descriptions and tensed propositions, implemented in a way similar to what Champollion (2015) suggests (see Comrie (1976), de Swart (1998) and Condoravdi (2002) for similar ideas). Readers interested in the details of Champollion's semantics are referred to his paper; here, we confine ourselves to aspects of his proposal that are relevant for our purposes.

Champollion's semantics is broadly Neo-Davidsonian with one major caveat: the event quantifier is introduced in the lexical entry of the verb rather than via existential closure. Accordingly, verbs and their projections up to the sentence level denote existential quantifiers over events, treated as predicates of sets of eventualities (of type $\langle vt,t\rangle$). As (20) illustrates, this means that a predicate such as *rain* is true of any set of events that contains a raining event (f ranges over event predicates).

(20) $[\![rain]\!] = \lambda f \exists e[\mathrm{rain}(e) \wedge f(e)]$ (Champollion, 2015: 39)

Sentential operators such as negation and modals are treated as functions from eventuality descriptions to eventuality descriptions (of type $\langle\langle vt,t\rangle,\langle vt,t\rangle\rangle$). Tense operates after all other operators have done their work: it maps the interpretation of the sentence to a truth value. Taken together, these assumptions mean that semantic scope in a simple sentence is as specified in (21): Tense has maximal scope, and the eventuality description has minimal scope. Scopal operators take scope between tense and the eventuality description.

(21) [Tense [{modal, negation, adverbs of quantification, ...} [eventuality description]]]

Because clauses in general can only be of two types in this system, t or $\langle vt,t\rangle$, the ambiguity of (2) is predicted: the DSR in (22a) results when the conjoined terms are of type t; the WSR in (22b) results when the conjoined terms are of type $\langle vt, t\rangle$ (and the tense operator as well as the negated modal outscope the conjunction).

(22) a. Semantic representation for (2) under the DSR:
Tense[¬◇(live-in(j,brc))]∧Tense[¬◇(live-in(m,ny))]
b. Semantic representation for (2) under the WSR:
Tense[¬◇(live-in(j,brc) ∧ live-in(m,ny))]

The unavailability of the WSR in the ungapped counterpart of (2), i.e. *John can't live in Barcelona and Mary can't live in New York*, follows from the usual constraint that the semantic type of conjuncts must match (Partee and Rooth, 1983) and the fact that tensed propositions are of type t.

4.3. Coordination

In this subsection, we present empirical evidence that supports our treatment of coordination sketched in previous subsections, according to which: (i) each conjunct can be interpreted independently, and (ii) a scopal element within the initial conjunct can outscope the entire coordination. In particular, we show that (ii) is not restricted to Gapping, contrary to a widespread assumption.

Huddleston and Pullum (2002: 1332-3) already noted cases of coordination in which some feature of the initial conjunct affects the interpretation of the entire coordination. In (23) an interrogative clause is coordinated with a declarative clause, but the sentence as a whole expresses a single question.

(23) Did you make your own contributions to a complying superannuation fund and your assessable income is less than \$31,000?
(Huddleston and Pullum (2002: 1332); originally from a tax form)

Huddleston and Pullum also discuss cases where a modal auxiliary in the initial conjunct is interpreted to outscope both conjuncts (ibid., p. 1333, fn. 53):

(24) It might be up there and I can't see it.
(Paraphrase: It might be that it is up there and I still can't see it.)

Note that these sentences have an asymmetric, consequential reading (similar to Kehler's (2002) Cause-Effect reading). If we assume that, in asymmetric coordination, the conjoined terms need not be alike in semantic type, the wide-scope of the question operator in (23) and the wide-scope modal in (24) follow from our treatment of coordination.[4]

Another piece of evidence supporting our analysis comes from the distribution of negative polarity items (NPIs). In (25a) the NPI *any* in the second conjunct is licensed by the negation *no* in the first conjunct. If we reverse the ordering of conjuncts, as in (25b), ungrammaticality

[4] An example case of asymmetric coordination involving type-mismatch is provided in (i), where an imperative is coordinated with a declarative:
(i) Drink this and you will lose 8 pounds of belly fat.
See Portner (2007) for arguments that imperatives and declaratives have distinct semantic types.

ensues, which suggests that the negation in the second conjunct is unable to outscope the entire coordination.[5]

(25) a. There is no medicine or any treatment whatsoever.
b. *There is any treatment or no medicine whatsoever.

Again, this supports our empirical claim that scopal elements within initial conjuncts can outscope the entire coordination while those in non-initial conjuncts cannot, irrespective of Gapping.

5. An analysis in Lexical Resource Semantics

In this section we spell out our analysis within the framework of Lexical Resource Semantics (LRS, Richter and Sailer, 2004). In Section 5.1 we offer a brief introduction to LRS as well as an LRS account of coordination. We will then present an example analysis of conjunctive Gapping and show how its two readings are captured.

5.1. Lexical Resource Semantics

LRS is an approach to semantic underspecification that expands to semantics the Head-Driven Phrase Structure Grammar approach to grammars as *descriptions* of structures (Pollard and Sag, 1994; Ginzburg and Sag, 2000). In particular, a grammar with LRS semantics denotes sets of syntactic structures that have fully explicit meaning representations in a standard logical language (Ty2, Gallin, 1975), but it does so through underspecification. In other words, the grammar of a sentence of English only describes properties of the logical representations that any utterance of that sentence must have, and those properties may describe more than one well-formed logical representation. More specifically, lexical items in LRS contribute semantic resources to utterances. Every utterance must use up all and only the semantic resources provided by the lexical (possibly phrasal) items in all their legitimate combinations. What is legitimate is determined by semantic principles which restrict at each phrase how the semantic resources of its daughters may combine. What these restrictions do not rule out is allowed. Scope ambiguities between co-arguments of a verb or between predicates in the first conjunct and the conjunction can be seen as arising from a lack of restriction of their respective scopes.

The lexical resources contributed by lexical items are the value of the INCONT attribute (for internal content) and the value of the attribute PARTS gathers the meaning contributions of all words in a phrase. One may regard the INCONT value of a sign as that part of the logical representation of that sign that is outscoped by any other operators with which the sign combines within its syntactic projection. The value of the EXCONT (external content) attribute, on the other hand indicates the overall logical form of phrases. Semantic composition is ensured by some general principles, some of which have case-based definitions with each case corresponding to a particular syntactic combination. Two general principles (the INCONT and EXCONT principles) basically ensure that the meaning contributed by all lexical items is part of the meaning of phrases they belong to. Given these general constraints on use of semantic resources contributed by words and phrases, the semantics principle summarized in (26) (adapted from Richter and Sailer, 2004) governs how to project and compose the meaning of daughters in local trees.

[5]We thank F. Mouret for alerting us to this possibility.

(26) SEMANTICS PRINCIPLE (SP): In each headed-phrase,
1. the EXCONT value of the head and the mother are identical,
2. the INCONT value of the head and the mother are identical,
3. the PARTS value contains all and only the elements of the PARTS values of the daughters,
4. the following conditions hold:
   (i) if the nonhead is a quantifier then its INCONT value is of the form $Qx[\rho \circ \nu]$, the INCONT value of the head is a component of ρ, and the INCONT value of the non-head daughter is identical with the EXCONT value of the head daughter,
   (ii) if the nonhead is a quantified NP with an EXCONT value of the form $Qx[\rho \circ \nu]$, then the INCONT value of the head is a component of ν
   (iii) ...

Clause 4 of the SP is what is critical for us, as it includes a case-based definition of constraints imposed on semantic composition by particular (subcases of) syntactic constructions. Clause 4i covers the combination of a quantifier and a head noun whereas clause 4ii covers the combination of a quantified NP argument and a verb. We add two additional clauses, discussed below, for coordinate structures.[6]

Syntactically, we assume that coordinate constructions have a binary branching structure, licensed by two rules: (i) one that allows a coordinating marker (such as *and* and *or*) to attach to an unmarked constituent, and (ii) the other that composes a coordinator-marked constituent with an unmarked constituent (Beavers and Sag, 2004; Chaves, 2007). Each of these syntactic rules are paired with an LRS constraint, (27) and (28), respectively.

(27) if the daughter is a coordinating marker then
a. the EXCONT value of the coordinating marker and the mother are of the form $\alpha \circ \beta$ (where $\circ$ represents Boolean conjunction and disjunction), and
b. the EXCONT value of the argument of the coordinating marker is a component of β.

(28) if one daughter is a coordinator-marked X (with an EXCONT value of the form $\alpha \circ \beta$), then the INCONT value of the other daughter is a component of α.

(27) imposes constraints on the combination of a coordinating marker and its argument (such as [*and*] [*Leslie speaks German*]). This constraint ensures that the conjunction contributed by the coordinating marker has wide scope over any (sub)expression contributed by its argument. (28), on the other hand, constrains the combination of two conjuncts, one of which marked by a coordinator (such as [*Bill speaks French*] [*and Leslie speaks German*]). This constraint ensures that the INCONT value of the first conjunct is a component of the conjoined meaning, but it imposes no constraint on the mother's EXCONT value. The DSR and WSR possibilities result precisely from this underspecification of the mother's EXCONT value, as is illustrated below in 5.2.

In this paper we use a notation for LRS which is based on the one in Penn and Richter (2004).

[6]Current versions of LRS mostly focus on headed phrases; it remains to be seen what general and case-based constraints are needed for nonheaded phrases. We leave discussion of this issue for future work.

The notation $\hat{}\alpha$ is used to express that the logical form α is the EXCONT value of the sign, whereas curly braces, as in $\{\beta\}$, indicate the sign's INCONT value. Square brackets with : indicate a *subterm* constraint: $\alpha : [\beta_1, ..., \beta_n]$ means that $\beta_1, ...\beta_n$ are subterms of α. In addition, lower case Greek letters will be used as meta-variables to indicate parts of logical forms which are not specified in the sign description.

5.2. Analysis

For purposes of exposition, we adopt a Davidsonian semantics as logical object language (Davidson, 1967). Representations in LRS are (partial) descriptions of terms in the object language. For illustration, in (29) we provide the denotation of the verb *live* (consistent with Champollion, 2015) and the corresponding description in LRS.

(29) a. Denotation of *live*:
$[\![live]\!] = \lambda f \exists e[\text{live}(e,x,y) \wedge f(e)]$
b. LRS description:
live: $\exists e(\{\text{live}(e,x,y)\} \wedge \phi : [e])$

The description in (29b) preserves all the information in (29a) except the INCONT specification added to it. The meta-variable ϕ represents some unknown formula which contains an event variable e. When the verb *live* composes with a tense-bearing auxiliary, ϕ will be identified with part of the tense meaning contributed by that auxiliary (more precisely, the relation between the time of eventuality and the speech time), although there are several other possible ways to specify ϕ.

We assume that modal auxiliaries in English contribute a modal as well as a tense meaning. This is illustrated by the denotation of *can't* and its LRS description in (30) (where V is eventive).[7]

(30) a. $[\![can't]\!] = \lambda V[t \circ s^* \wedge \neg\Diamond V(\lambda e[\tau(e) \subseteq_T t])]$
b. *can't*: $t \circ s^* \wedge \neg\Diamond\psi : [e,\ \tau(e) \subseteq_T t]$

The description in (30b) contains a present tense meaning ($t \circ s^* \wedge ..., \tau(e) \subseteq_T t$) and a negated possibility modal ($\neg\Diamond$...); s^* denotes the contextually given time of speech and $\tau(e)$ denotes the time of the eventuality e (Krifka, 1998). The meta-variable ψ is where the eventuality description containing the event variable e as well as the subformula $\tau(e) \subseteq_T t$ is introduced. This ensures that the eventuality description has narrow scope over the modal operator and does not outscope the tense meaning.

Since nothing depends on the precise syntactic analysis we adopt, we assume that the lexical descriptions in (29b)-(30b) and the constants j (for *John*) and brc (for *in Barcelona*) combine in the usual way to produce the description in (31).

(31) *John can't live in Barcelona*: $t \circ s^* \wedge \neg\Diamond\exists e(\text{live}(e,\text{j},\text{brc}) \wedge \tau(e) \subseteq_T t)$

[7] As it is, this analysis of auxiliaries undergenerates. To account for the fact that modals can scopally interact with quantifiers (as in *Someone can't be here*), we need to introduce a new meta-variable, γ (Richter and Sailer, 2004):
(i) *can't*: $\hat{}t \circ s^* \wedge \gamma : [\neg\Diamond\psi : [e,\ \tau(e) \subseteq_T t]]$
This description permits both the (i) Q (quantifier) $> \neg\Diamond$ and (ii) $\neg\Diamond >$ Q readings: (i) results when Q is identified with γ, and (ii) results when it is identified with ψ. Since the present paper is not concerned with quantifiers, we assume the simplified description in (30b) for ease of exposition.

Finally, for the gapped clause *Mary in New York* we assume the description in (32).

(32) *Mary in New York*: $\hat{}\delta$: [m,ny,ω]

This description says that *Mary in New York* has an unknown EXCONT value δ and that δ includes subterms m and ny (for *Mary* and *New York*) as well as some formula ω that represents the logical representation that corresponds to the gap.

With everything in place we now present our LRS analysis of (2). Figure 1 shows the syntactic structure of (2) along with the LRS descriptions and constraints added by (27) and (28) above (Boxed integers are tags).

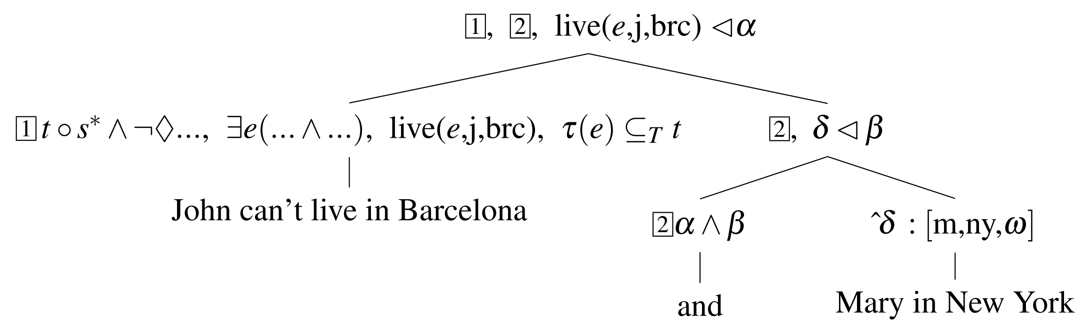

Figure 1: The LRS syntax-semantics interface for (2)

Recall that the constraints in (27) and (28) impose different requirements on the first vs. second conjuncts: all semantic resources contributed by the second conjunct must be a component of the conjoined meaning ($\delta \lhd \beta$), but for the first conjunct we only require that its INCONT value be a component of the conjoined meaning (live(e,j,brc) $\lhd\alpha$). Given this, two possibilities are predicted for the overall logical form of (2): the conjunction takes wide-scope ($\boxed{2} > \boxed{1}$) or the tense and modal meanings take wide-scope ($\boxed{1} > \boxed{2}$). In (33) and (34) we indicate the meta-variable assignments which satisfy all relevant requirements. (To make the descriptions more readable the logical forms that correspond to *can't* and *and* are highlighted in boldface.)

(33) LRS constraints for the DSR of (2)

a. $\alpha = t \circ s^* \wedge \neg\Diamond\exists e(\text{live}(e,\text{j,brc}) \wedge \tau(e) \subseteq_T t)$
$\beta = \delta = t' \circ s^* \wedge \neg\Diamond\exists e'(\text{live}(e',\text{m,ny}) \wedge \tau(e') \subseteq_T t')$
$\omega = t' \circ s^* \wedge \neg\Diamond\exists e'(\text{live}(e',x,y) \wedge \tau(e') \subseteq_T t')$

b. Semantic representation resulting from the meta-variable assignment in (33a):
$[t \circ s^* \wedge \boldsymbol{\neg\Diamond}\exists e\,(\text{live}(e,\text{j,brc}) \wedge \tau(e) \subseteq_T t)]\ \boldsymbol{\wedge}\ [t' \circ s^* \wedge \boldsymbol{\neg\Diamond}\exists e'(\text{live}(e',\text{m,ny}) \wedge \tau(e') \subseteq_T t')]$

(34) LRS constraints for the WSR of (2)

a. $\alpha = \exists e(\text{live}(e,\text{j,brc}) \wedge \tau(e) \subseteq_T t)$
$\beta = \delta = \exists e'(\text{live}(e',\text{m,ny}) \wedge \tau(e') \subseteq_T t')$
$\omega = \exists e'(\text{live}(e',x,y) \wedge \tau(e') \subseteq_T t')$

b. Semantic representation resulting from the variable assignment in (34a):
$t \circ s^* \wedge \boldsymbol{\neg\Diamond}[\exists e(\text{live}(e,\text{j,brc}) \wedge \tau(e) \subseteq_T t)\ \boldsymbol{\wedge}\ \exists e'(\text{live}(e',\text{m,ny}) \wedge \tau(e') \subseteq_T t')]$

In the DSR of (2), depicted in (33b), each conjunct denotes a tensed proposition. In this reading the subformula that corresponds to the semantics at the gap (i.e. ω) comprises the tense and modal meanings as well as the semantic resource contributed by the predicate *live*. In the description of the WSR of (2), depicted in (34b), each conjunct denotes an eventuality description, and there is a single instance of tense and modal taking wide-scope over the conjoined eventuality description.

6. Conclusion

We have shown in this paper that the DSR/WSR ambiguity in Gapping receives a simple solution within a semantic underspecification approach to the syntax/semantics interface such as LRS. This ambiguity follows directly from the way LRS works together with independently motivated constraints on coordination and semantic scope in simple sentences. If this analysis is correct, there is no need to stipulate a grammatical ambiguity or any Gapping-specific assumptions. Instead, the various readings of Gapping sentences follow from an independently motivated underspecification of what is being conjoined and a general theory of ellipsis.

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Use-conditional meaning in Rational Speech Act models[1]

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Abstract. Motivated by shortcomings in the modeling of repeated utterances in Burnett's *Rational Speech Act* (RSA) model of social meaning, we propose an alternative analysis in terms of use-conditional meaning, which we implement in an extended RSA framework. We show that it can not only model the production of a sequence of utterances throughout a discourse, but also captures the similarities between social and expressive meaning.

Keywords: social meaning, use-conditional meaning, Rational Speech Act models.

1. Introduction

Since Labov (1963), *variationist sociolinguistics* has studied the subtle meaning differences between linguistic variants (see Eckert, 2012 for an overview).

(1) a. I am walking (velar *-ing* variant)
    b. I am walkin' (apical *-in'* variant)

For example, (1a) and (1b) have the same truth conditions, but after hearing them, listeners tend to infer different properties of the speaker: (1a) is associated with education, intelligence, articulateness (clustered as **competent**), and formality and distance (clustered as **aloof**) whereas (1b) is associated with the opposite properties (Campbell-Kibler, 2006, 2007, 2008, 2009). To the extent that the inference patterns are different, we can say that the variants in (1) have different *social meanings*. Moreover, people's production of language is sensitive to such social meanings and the context. For instance, Labov (2012) analyzes President Obama's use of (ING) in three recordings taken in three contexts with different levels of formality and finds 72% *-in'* at a barbecue, 33% at the press event that followed and 3% in his DNC acceptance speech.

These rich sociolinguistic phenomena have the potential to connect to semantics and pragmatics. Two fundamental research questions are (i) how to represent social meaning in the semantics and (ii) how to integrate it into the pragmatics. Burnett (2017, 2019) pioneers the use of Bayesian Rational Speech Act (RSA) models (Frank and Goodman, 2012; Goodman and Frank, 2016) to address these questions. In this paper we explore the connections between social meaning and semantics/pragmatics further. In particular, we address the following questions.

1. Empirically, what properties does social meaning have that resemble those studied in the semantics/pragmatics literature?
2. Theoretically, how do we semantically represent social meaning to capture these properties and model people's use of social meaning in production and comprehension?

The rest of the paper is organized as follows: in section 2, we list empirical properties that social meaning shares with expressive meaning. In section 3, we review and assess Burnett's

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(2017, 2019) analysis of social meaning in the standard RSA framework, focusing on an issue that it has in modeling the production of a sequence of utterances throughout a discourse. In section 4, we propose an alternative analysis of social meaning in the spirit of Kaplan's (1999) use-conditional meaning, implement it in an extended RSA framework, and show that it can not only model the production of a sequence of utterances throughout a discourse, but can also capture the similarities between social and expressive meaning. We then discuss how this enriched RSA framework can serve as a general paradigm for other use-conditional meanings in section 5.

2. Social meaning and expressive meaning

Potts (2007) summarizes a list of empirical properties of *expressive meanings* (2).[2]

(2) Expressive meanings are

- largely independent of the descriptive meanings (Independence)
- always about the utterance situation itself. (Nondisplaceability)
- not propositional and can be hard to pin down (Descriptive ineffability)
- performative in that the very act of utterance conveys the meaning (Immediacy)
- strengthened when repeated without redundancy (Repeatability)

We note that social meaning also shares these properties. As a concrete example, consider the social meanings of the *-in'* variant discussed in section 1.

(3) John likes walkin'
$\rightsquigarrow$ The speaker is **incompetent**
$\rightsquigarrow$ The speaker is **friendly**

Let us check whether such social meanings also have the properties in (2):

- Independence: The social meanings of (3), which are about its speaker, are indeed independent of its descriptive meaning (i.e., the proposition that John likes walking).
- Nondisplaceability: The social meanings of *-in'* are about the speaker of the utterance, and therefore about the utterance situation itself. For instance, the social meanings of (4) are about its speaker, even though the *-in'* variant is embedded under past tense and *said*.

(4) Mary said that John was walkin'.
$\rightsquigarrow$ The speaker is **incompetent**
$\rightsquigarrow$ The speaker is **friendly**

- Descriptive ineffability: The social meaning of *-in'* is hard to pin down. The propositions in (3) are only approximations.
- Immediacy: Social meanings are performative. It is the very act of using the *-in'* variant that conveys its social meaning.

[2]For simplicity, we do not discuss the property of *perspective dependence* in Potts's list, but note that his treatment of it can be similarly incorporated in our proposal.

- Repeatability: the repeated use of the *-in'* variant can strengthen its social meaning without redundancy. For instance, the inferences in (5) can be stronger than in (3).

(5) John likes walkin'. Mary likes runnin'. Bob likes swimmin'.
$\rightsquigarrow$ The speaker is **incompetent**
$\rightsquigarrow$ The speaker is **friendly**

In sum, the empirical properties of expressive meanings in (2) are also shared by social meanings. These are properties that need to be accounted for by our analysis of social meaning.

3. Burnett's (2017, 2019) analysis of social meaning in the standard RSA framework

3.1. The Rational Speech Act (RSA) framework

Burnett's analysis is based on a Bayesian game-theoretic pragmatics framework, which provides a probabilistic formalization of Gricean reasoning (Frank and Goodman 2012; Goodman and Frank 2016; see also Franke 2009). In this framework, listeners and speakers recursively reason about each other (6).

(6) a. $L_0(w \mid u) \propto \Pr(w) \cdot [\![u]\!](w)$ — Literal listener
b. $S_1(u \mid w) \propto \textbf{Optimize}(L_0(w \mid u))$ — Pragmatic speaker
c. $L_1(w \mid u) \propto \Pr(w) \cdot S_1(u \mid w)$ — Pragmatic listener

We will use a concrete example discussed by Burnett (2017) to illustrate the basics of this framework. Suppose you left three cookies on the dinner table for your roommates. When you come home, John, one of the roommates, tells you (7).

(7) I ate some of the cookies.

You will likely infer from (7) that John ate one or two cookies but probably not all three. An intuitive explanation is that if he had eaten all three cookies he would have told you (8), which is more informative.[3] How do we formalize this reasoning in the probabilistic framework above?

(8) I ate all of the cookies.

First, we consider a literal listener (6a), who interprets an utterance u simply based on its truth-conditional content $[\![u]\!]$. This can be seen as a probabilistic generalization of a Stalnakerian model of conversation: instead of treating a *context* C as a set of possible worlds, a context is now treated as a probability distribution $P(\cdot)$ over possible worlds. Updating an initial context (implemented as a *prior distribution* $\Pr(\cdot)$) with an utterance u results in a new context, i.e., the conditional probability $L_0(\cdot \mid u)$, obtained by probabilistic *conditioning* (9b) (cf. the traditional contextual update via set intersection (9a)).

(9) a. $C + u = C \cap [\![u]\!]$
b. $L_0(w \mid u) \propto \Pr(w) \cdot [\![u]\!](w)$

Concretely, in the cookie example, let w_i be the possible world in which John ate exactly i cookies ($i = 0, 1, 2, 3$). Just for illustration let us assume that the prior probabilities of w_0 to w_4 are 0.1, 0.4, 0.3, and 0.2, respectively (first row in (10)).

[3] Assume that it is clear that eating all three cookies is totally acceptable, so John would have no reason to hide the fact if he did eat them all.

(10) Literal listener after hearing *I ate some of the cookies*

	w_0	w_1	w_2	w_3
$\Pr(w)$	.1	.4	.3	.2
$[\![\text{some}]\!](w)$	0	1	1	1
$\Pr(w) \cdot [\![\text{some}]\!](w)$	0	.4	.3	.2
$L_0(w \mid \text{some})$	0	$\frac{4}{9}$	$\frac{3}{9}$	$\frac{2}{9}$

The utterance *I ate some of the cookies* is true in w_1, w_2, and w_3, i.e., $[\![\text{some}]\!](w_0) = 0$ and $[\![\text{some}]\!](w_i) = 1$ for $i = 1,2,3$ (second row in (10)). Based on the prior distribution $\Pr(\cdot)$ and the truth-conditional meaning $[\![\text{some}]\!]$, we compute their product in the third row in (10). The proportionality operator $\propto$ in (9b) means that its left term is obtained by multiplying a constant to the right term to ensure that the left term is a probability distribution (i.e., all the probabilities sum up to 1). This is done by dividing each element in the third row of (10) by the sum of that row, and the resulting conditional probabilities $L_0(w \mid \text{some})$ are shown in the last row. Note that $L_0(w_3 \mid \text{some}) = 2/9 \approx .22$, which means that after hearing *I ate some of the cookies*, the literal listener thinks it is roughly 22% likely that John ate all 3 cookies.

Similarly, the conditional probabilities $L_0(w \mid \text{all})$ are computed in (11).

(11) Literal listener after hearing *I ate all of the cookies*

	w_0	w_1	w_2	w_3
$\Pr(w)$	.1	.4	.3	.2
$[\![\text{all}]\!](w)$	0	0	0	1
$\Pr(w) \cdot [\![\text{all}]\!](w)$	0	0	0	.2
$L_0(w \mid \text{all})$	0	0	0	1

Note that $L_0(w_3 \mid \text{all}) = 1$, which means that after hearing *I ate all of the cookies*, the literal listener is completely sure that John ate all 3 cookies.

Now we will consider a pragmatic speaker, whose definition (6b) is repeated below as (12) to formalize the reasoning "if John had eaten all three cookies, he would have used *all* instead of *some* because *all* is more informative."

(12) $S_1(u \mid w) \propto \textbf{Optimize}(L_0(w \mid u))$ Pragmatic speaker[4]

What (12) says is that the probability of a pragmatic speaker choosing utterance u in world w is determined by optimizing (in some sense) the probability the literal listener assigns to w after hearing u. For the purposes of the current paper we only require that **Optimize** satisfies (13), i.e., the pragmatic speaker would be more likely to choose u than u' in world w iff the literal listener would assign higher probability to world w after hearing u than u'.[5]

(13) $S_1(u \mid w) > S_1(u' \mid w)$ iff $L_0(w \mid u) > L_0(w \mid u')$

[4]Here we make the simplifying assumption that all relevant utterances are equally likely *a priori*. A more realistic speaker model that takes into account utterance priors would be $S_1(u \mid w) \propto \Pr(u) \cdot \textbf{Optimize}(L_0(w \mid u))$. The simplification made here does not affect the main points of this paper.

[5]In many RSA models *a priori* preferences for utterances are represented as *costs* and the **Optimize** function is sensitive to them. In such cases (13) does not hold in general, but it still holds when all relevant utterances are assumed to be equally likely *a priori*.

In the cookie example, given that $L_0(w_3 \mid \text{all}) = 1 > L_0(w_3 \mid \text{some}) = 2/9$, from (10) we have $S_1(\text{all} \mid w_3) > S_1(\text{some} \mid w_3)$, i.e., the speaker would prefer to use *all* to *some* if he had eaten all 3 cookies.

Once we choose an exact definition of **Optimize**, we can make quantitative predictions about the production probabilities and apply Bayes' rule to make quantitative predictions about how a pragmatic listener would interpret an utterance (6c).

3.2. Personae and Eckert-Montague fields

In order to apply the RSA framework to analyze social meaning, we need to address two issues: (i) What do possible worlds represent? (ii) How do we represent social meaning?

Burnett (2019) uses Obama's use of (ING) as a working example and assume two candidate utterances $u_{\textit{-ing}}$ and $u_{\textit{-in'}}$ that are different only in terms of the realization of (ING).

For (i), Burnett uses possible worlds to represent the speaker's possible *personae*. A persona i is a maximally compatible set of properties. In the Obama example, Burnett assumes that the relevant properties are **competent** and **aloof** and their opposites. The four possible personae and their names are in the table below (14).

(14)

STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
{**comp.**, **aloof**}	{**comp.**, **friendly**}	{**incomp.**, **aloof**}	{**incomp.**, **friendly**}

For (ii), Burnett essentially treats an utterance u's association with certain properties as a compatibility relation and uses type lifting to derive the set of personae that u is compatible with (i.e., treating personae as Montagovian individuals). A persona is compatible with u iff it contains a property that is compatible with u. Given that $u_{\textit{-ing}}$ is compatible with both **competent** and **aloof**, the only persona incompatible with $u_{\textit{-ing}}$ is DOOFUS. Similarly, since $u_{\textit{-ing}}$ is compatible with both **incompetent** and **friendly**, the only persona incompatible with $u_{\textit{-in'}}$ is STERN LEADER. Burnett calls such compatibility relations between linguistic variants and personae *Eckert-Montague fields* and uses them in the literal listener model as representations of social meaning (15).

(15)

	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
⟦*-ing*⟧	1	1	1	0
⟦*-in'*⟧	0	1	1	1

As a concrete example, Burnett models Obama's use of (ING) at the barbecue as follows. She assumes that, because Obama is the president, the prior probability distribution slightly favors personae that are **aloof** (i.e., STERN LEADER and ASSHOLE) than those that are **friendly** (i.e., COOL GUY and DOOFUS) (first row in (16)). Given the Eckert-Montague field of the *-ing* variant (second row in (16)), the probability that the literal listener assigns to each persona after hearing the *-ing* variant can be calculated according to (6a) and is shown in the last row in (16). In particular, $L_0(\text{COOL GUY} \mid \textit{-ing}) = 2/8 = .25$. That is, after hearing the *-ing* variant, the literal listener thinks that it is 25% likely that Obama is a COOL GUY.

(16) Literal listener after hearing *-ing*

Persona i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\Pr(i)$	.3	.2	.3	.2
$[\![\textit{-ing}]\!](i)$	1	1	1	0
$L_0(i \mid \textit{-ing})$	$\frac{3}{8}$	$\frac{2}{8}$	$\frac{3}{8}$	0

Similarly, the probability that the literal listener assigns to each persona after hearing the *-in'* variant is calculated in (17). In particular, $L_0(\text{COOL GUY} \mid \textit{-in'}) = 2/7 \approx .286$.

(17) Literal listener after hearing *-in'*

Persona i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\Pr(i)$	.3	.2	.3	.2
$[\![\textit{-in'}]\!](i)$	0	1	1	1
$L_0(i \mid \textit{-in'})$	0	$\frac{2}{7}$	$\frac{3}{7}$	$\frac{2}{7}$

Given that $L_0(\text{COOL GUY} \mid \textit{-in'}) > L_0(\text{COOL GUY} \mid \textit{-ing})$, from (13) we can conclude that $S_1(\textit{-in'} \mid \text{COOL GUY}) > S_1(\textit{-ing} \mid \text{COOL GUY})$, i.e., assuming that Obama wants to convey the COOL GUY persona, he would prefer the *-in'* variant to the *-ing* variant. Recall that in this context Obama in fact uses *-in'* 72% of the time. Therefore, it seems that Burnett's model correctly captures Obama's use of (ING) in this case. (In fact, using a standard implementation of the **Optimize** function, she is able to configure the model so that $S_1(\textit{-in'} \mid \text{COOL GUY})$ is predicted to be around 69%.)

3.3. The issue with multiple utterances

However, when we examine more closely Burnett's model's prediction $S_1(\textit{-in'} \mid \text{COOL GUY})$, it is not clear whether this truly captures Obama's production rate of *-in'*.

Crucially, note that $S_1(\textit{-in'} \mid \text{COOL GUY})$ is implicitly relative to the literal listener's prior probability distribution over personae. This gives rise to the important question of how such a probability distribution should change over the entire discourse, which may consist of multiple utterances in a sequence. To address this, recall that the literal listener model can be seen as a probabilistic generalization of a Stalnakerian model (9), repeated below as (18).

(18) a. $C + u = C \cap [\![u]\!]$
b. $L_0(i \mid u) \propto \Pr(i) \cdot [\![u]\!](i)$

If we have a second utterance u_2 following the first u_1, in a Stalnakerian model we can take the output context $C' = C + u_1$ as the input context of u_2. By analogy, we can use the conditional probability $L_0(w \mid u_1)$ as the new prior probability $\Pr'(w)$ in the literal listener model (19).

(19) $L_0'(i \mid u_2) \propto \Pr'(i) \cdot [\![u_2]\!](i)$

In general, for a sequence of utterances $u_1, \ldots, u_{n+1}$, we can define the literal listener model recursively as in (20).

(20) $L_0^{(n)}(i \mid u_1, \ldots u_{n+1}) \propto \Pr^{(n)}(i) \cdot [\![u_{n+1}]\!](i), \quad \Pr^{(n+1)}(w) = L_0^{(n)}(i \mid u_1, \ldots u_{n+1})$

As notational variants we will write $L_0^{(0)}, \Pr^{(0)}$ simply as $L_0, \Pr$, write $L_0^{(1)}, \Pr^{(1)}$ as $L_0', \Pr'$, write $L_0^{(2)}, \Pr^{(2)}$ as $L_0'', \Pr''$, etc. Also, when the initial sequence $u_1, \ldots, u_n$ is clear from the context, we will write $L_0^{(n)}(i \mid u_{n+1})$ instead of $L_0^{(n)}(i \mid u_1, \ldots u_{n+1})$

Once the literal listener is defined over a sequence of utterances, the pragmatic speaker model can be similarly generalized (21).

(21) $S_1^{(n)}(u_{n+1} \mid i) \propto \textbf{Optimize}(L_0^{(n)}(i \mid u_{n+1}))$

Now let us consider what Burnett's model predicts when the speaker needs to make multiple utterances, again using Obama's use of (ING) as a concrete example.

From the previous discussion we already know that $S_1(\textit{-in'} \mid \text{COOL GUY}) > S_1(\textit{-ing} \mid \text{COOL GUY})$ and therefore let us assume that Obama first chooses the *-in'* variant and see what the model predicts about his second utterance.

In this case, the probability that the literal listener assigns to each persona after hearing *-ing* as the second utterance is computed in (22). Note that the prior $\Pr'(i)$ is by definition $L_0(i \mid \textit{-in'})$, i.e., the last row in (17).

(22) Literal listener after first hearing *-in'* and then *-ing*

Persona i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\Pr'(i)$	0	$\frac{2}{7}$	$\frac{3}{7}$	$\frac{2}{7}$
$[\![\text{-ing}]\!](i)$	1	1	1	0
$L_0'(i \mid \textit{-ing})$	0	$\frac{2}{5}$	$\frac{3}{5}$	0

Similarly, the probability that the literal listener assigns to each persona after hearing *-in'* as the second utterance is computed in (23). Note that the conditional probability $L_0'(i \mid \textit{-in'})$ is identical to the prior $\Pr'(i)$: Since all the personae with non-zero prior probabilities are already compatible with the *-in'* variant, no information is gained from hearing it.

(23) Literal listener after first hearing *-in'* and then *-in'* again.

Persona i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\Pr'(i)$	0	$\frac{2}{7}$	$\frac{3}{7}$	$\frac{2}{7}$
$[\![\text{-in'}]\!](i)$	0	1	1	1
$L_0'(i \mid \textit{-in'})$	0	$\frac{2}{7}$	$\frac{3}{7}$	$\frac{2}{7}$

Since we have $L_0'(\text{COOL GUY} \mid \textit{-ing}) = \frac{2}{5} > L_0'(\text{COOL GUY} \mid \textit{-in'}) = \frac{2}{7}$, from (13) we conclude that $S_1'(\textit{-ing} \mid \text{COOL GUY}) > S_1'(\textit{-in'} \mid \text{COOL GUY})$. That is, after using the *-in'* variant once, it is no longer preferred, because it is not informative anymore.

Finally, let us assume that Obama first uses *-in'*, and then *-ing*, and see what Burnett's model predicts about the third utterance.

In this case, the probability that the literal listener assigns to each persona after hearing *-ing* as the third utterance is computed in (24). Note that the prior $\Pr''(i)$ by definition comes from the last row in (22). Also note that the conditional probability $L_0''(i \mid \textit{-ing})$ is identical to the prior $\Pr''(i)$, because all the persona with non-zero priors are already compatible with *-ing*.

(24) Literal listener after first hearing *-in'*, followed by *-ing*, and then *-ing*

Persona i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\mathrm{Pr}''(i)$	0	$\frac{2}{5}$	$\frac{3}{5}$	0
$[\![\text{-ing}]\!](i)$	1	1	1	0
$L''_0(i \mid \textit{-ing})$	0	$\frac{2}{5}$	$\frac{3}{5}$	0

Similarly, the probability that the literal listener assigns to each persona after hearing *-in'* as the third utterance is computed in (25). Once again, note that the conditional probability $L''_0(i \mid \textit{-in'})$ is also identical to the prior $\mathrm{Pr}''(i)$.

(25) Literal listener after first hearing *-in'*, followed by *-ing*, and then *-in'*

Persona i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\mathrm{Pr}''(i)$	0	$\frac{2}{5}$	$\frac{3}{5}$	0
$[\![\text{-in'}]\!](i)$	0	1	1	1
$L''_0(i \mid \textit{-in'})$	0	$\frac{2}{5}$	$\frac{3}{5}$	0

Since we have $L''_0(\text{COOL GUY} \mid \textit{-ing}) = \frac{2}{5} = L''_0(\text{COOL GUY} \mid \textit{-in'})$, from (13) we conclude that $S''_1(\textit{-ing} \mid \text{COOL GUY}) = S''_1(\textit{-in'} \mid \text{COOL GUY})$. That is, after using both *-in'* and *-ing* variants once, Burnett's model predicts that the speaker should have no preference for either variant.

In sum, Burnett's model predicts that at the barbecue (i) Obama would initially prefer the *-in'* variant, (ii) after he has produced one variant but not both, he would prefer the one he has not produced, and (iii) after he has produced both variants, he would be indifferent. Together, this means that Obama's production rate of *-in'* is predicted to be around 50% when the speech is sufficiently long (i.e., there are enough instances of (ING) after he produces both variants), contrary to fact.

Note that the problem with multiple utterances does not crucially rely on the way the sequential update of the prior distribution is defined in (20). For instance, after hearing the first *-in'*, we can compute the pragmatic listener's interpretation $L_1(i \mid \textit{-in'})$ and use it as the new prior $\mathrm{Pr}'(i)$, instead of using $L_0(i \mid \textit{-in'})$ as $\mathrm{Pr}'(i)$. However, the same problem will arise, because it is still the case that every persona i whose new prior $\mathrm{Pr}'(i)$ is greater than 0 is already compatible with *-in'*. This means that *-in'* is totally uninformative (i.e., $L'_0(i \mid \textit{-in'})$ is identical to $\mathrm{Pr}'(i)$) and therefore will never be preferred.

However, we note that this problem does depend on the simplifying assumption that the persona intended by the speaker stays constant throughout the sequence of utterances in the discourse. If we give up this assumption, and analyze the social meaning of a linguistic variant as a proposition relativized to the utterance time t (e.g., the meaning of *-ing* is "I am competent or aloof *now*"), then the repeated use of a variant can be informative because two instances of use correspond to different propositions (e.g., "I am competent or aloof at t_1/t_2").

Although such an approach can potentially rescue Burnett's analysis, many more complicated issues need to be addressed to provide a realistic model. For instance, in order to calculate the speaker's production rate of a variant over a sequence of utterances in the discourse, we will need to specify how the prior over personae is updated throughout the discourse, which is more complicated because we need to take into account the potential change in persona.

Therefore, we conclude that Burnett's analysis faces difficulties in modeling the production of a sequence of utterances throughout the discourse. In the next section, we propose an alternative analysis of social meaning in terms of use-conditional meaning, and show that it not only can easily model the production of a sequence of utterances throughout the discourse, but also captures the similarities between social meaning and expressive meaning very well.

4. Social meaning as use-conditional meaning

4.1. Use-conditional meaning

According to Kaplan (1999), the meanings of expressions such as *ouch* and *oops* are not captured by their truth conditions (since they do not have any), but rather by their conditions on use, i.e., contexts in which they can be correctly/felicitously used. For instance, the use condition of *oops* can be roughly characterized as follows: *oops* is felicitously used iff the speaker observes a minor mishap. Knowing this use condition, the listener of *oops* can infer that the speaker observes a minor mishap, by virtue of knowing what it takes for the speaker to produce this utterance.

In the case of social meaning on the one hand, the choice of variant is not totally constrained by linguistic norms. For instance, anybody may use *-ing* and *-in'* and using either variant would be correct. On the other hand, we can still apply Kaplan's insight to analyze social meaning, in that the hearer of a linguistic variant can gain information about the speaker, by virtue of knowing (or more precisely, having an ideology about) what it takes for the speaker to produce that variant, which often has to do with the speaker's social identity, or *persona*.

Therefore, we suggest that social meaning should be represented as the listener's ideology about how the speaker's persona influences his/her choice of the linguistic variants. Below we formalize this idea in an extended RSA framework.

4.2. Implementing use-conditional meaning in an extended RSA framework

We generalize the literal listener to integrate both the truth-conditional (26a) and use-conditional (26b) meanings of an utterance.

(26) $L_0(w,i \mid u) = L_0(w \mid u) \cdot L_0(i \mid u)$

a. $L_0(w \mid u) \propto \Pr(w) \cdot [\![u]\!](w)$ — $[\![u]\!]$: truth-conditional meaning

b. $L_0(i \mid u) \propto \Pr(i) \cdot S_0(u \mid i)$
where $S_0(u \mid i)$ is a *stereotypical speaker* — $S_0(u \mid i)$: use-conditional meaning

The literal listener updates their prior belief about the world w by conditioning on the truth of the utterance u (26a). Meanwhile, they update their prior belief about the speaker type i by reasoning about a hypothetical *stereotypical speaker* S_0.[6] Crucially, this speaker is *not* a production model of any real linguistic agent, but rather one that is based on ideological stereotypes. For instance, the stereotype that incompetent but friendly people tend to use the *-in'* variant corresponds to a high value for S_0(*-in'* | DOOFUS), while the stereotype that competent but aloof people tend to use the *-ing* variant corresponds to a low value of S_0(*-in'* | DOOFUS). Assuming that the production probabilities of the other two personae are in between, we take (27) as an example representation of the social meaning of *-in'* and use it to model Obama's use of (ING) at the barbecue.

[6]See Henderson and McCready's (2017) analysis of dogwhistles for another case of using a speaker model S_0 as the starting point of the iterative reasoning.

(27)

i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
S_0(*-in'* | i)	0.1	0.7	0.2	0.9

4.3. Multiple utterances

First, we consider Obama's first utterance. Assuming the same prior probability distribution over personae as before, which slightly favors personae that are **aloof**, the probability that the literal listener assigns to each persona after hearing *-in'* is computed in (28).

(28) Literal listener after hearing *-in'*

i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\Pr(i)$	0.3	0.2	0.3	0.2
S_0(*-in'* | i)	0.1	0.7	0.2	0.9
$\Pr(i) \cdot S_0$(*-in'* | i)	0.03	0.14	0.06	0.18
L_0(i | *-in'*)	0.073	0.34	0.146	0.439

Similarly, the probability that the literal listener assigns to each persona after hearing *-ing* is computed in (29). Note that S_0(*-ing* | i) $= 1 - S_0$(*-in'* | i) for each persona i.

(29) Literal listener after hearing *-ing*

i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\Pr(i)$	0.3	0.2	0.3	0.2
S_0(*-ing* | i)	0.9	0.3	0.8	0.1
$\Pr(i) \cdot S_0$(*-ing* | i)	0.27	0.06	0.24	0.02
L_0(i | *-ing*)	0.458	0.102	0.407	0.034

Since L_0(COOL GUY | *-in'*) $= 0.34 > 0.102 =$ L_0(COOL GUY | *-ing*), from (13) we conclude that S_1(*-in'* | COOL GUY) $>$ S_1(*-ing* | COOL GUY). That is, Obama would initially prefer *-in'* to *-ing* to construct the COOL GUY persona.

Now suppose Obama chooses *-in'* as the first utterance. The probabilities that the literal listener assigns to each persona after hearing *-in'* or *-ing* as the second utterance are shown in (30).

(30) Literal listener after hearing *-in'* first, and then *-in'* or *-ing* ($\Pr'(i) = L_0$(i | *-in'*))

i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\Pr'(i)$	0.073	0.34	0.146	0.439
S_0(*-in'* | i)	0.1	0.7	0.2	0.9
L'_0(i | *-in'*)	0.011	0.356	0.044	0.589
L'_0(i | *-ing*)	0.2	0.311	0.356	0.133

Since L'_0(COOL GUY | *-in'*) $= 0.356 > 0.311 =$ L'_0(COOL GUY | *-ing*), from (13) we conclude that S'_1(*-in'* | COOL GUY) $>$ S'_1(*-ing* | COOL GUY). That is, after using the *-in'* variant once, Obama would still prefer it to *-ing* as the second utterance to construct the COOL GUY persona. This prediction is in stark contrast with Burnett's model's, according to which Obama would prefer *-ing* as the second utterance once he has used *-in'* as the first utterance. The reason is that in our model *-in'* never completely rules out any persona and therefore its repeated use can still be informative, whereas in Burnett's model, repeated use of *-in'* is never informative and therefore the repeated use is never preferred.

Now suppose Obama chooses *-in'* as the first and second utterances. The probabilities that the literal listener assigns to each persona after hearing *-in'* or *-ing* as the third utterance are shown in (31).

(31) Literal listener after hearing *-in'* twice, and then *-in'* or *-ing* $(\mathrm{Pr}''(i) = L_0'(i \mid \textit{-in'}))$

i	STERN LEADER	COOL GUY	ASSHOLE	DOOFUS
$\mathrm{Pr}''(i)$	0.011	0.356	0.044	0.589
$S_0(\textit{-in'} \mid i)$	0.1	0.7	0.2	0.9
$L_0''(i \mid \textit{-in'})$	0.001	0.316	0.011	0.672
$L_0''(i \mid \textit{-ing})$	0.047	0.508	0.166	0.28

Since $L_0''(\text{COOL GUY} \mid \textit{-in'}) = 0.316 < 0.508 = L_0''(\text{COOL GUY} \mid \textit{-ing})$, from (13) we conclude that $S_1''(\textit{-in'} \mid \text{COOL GUY}) < S_1''(\textit{-ing} \mid \text{COOL GUY})$. That is, after using *-in'* twice, Obama would prefer to use *-ing* as the third utterance to construct the COOL GUY persona.

This ensures that Obama will not use the *-in'* variant indefinitely. Intuitively, this is because using the *-in'* variant too much will make the listener assign too much probability to the DOOFUS persona, since that persona corresponds to the highest production rate of *-in'*.

In general, the speaker's best strategy to convey the intended persona i to the listener over multiple utterances is to produce *-in'* at the rate that conforms to the stereotype of that persona i, i.e., $S_0(\textit{-in'} \mid i)$. For example, Obama's best strategy to convey the COOL GUY persona is to produce the *-in'* variant 70% of the time. We suggest that this captures the performative nature of social meaning: the speaker can succeed in conveying an intended persona iff the way he/she produces the utterances conforms to the way the intended persona is supposed to produce those utterances. In other words, it is the very act of using linguistic variants in a particular way that constructs and conveys the corresponding persona.

4.4. Capturing properties of expressive meanings

As discussed earlier, social meaning shares many properties of expressive meanings (2), repeated below as (32).

(32) Expressive meanings are

- largely independent of the descriptive meanings (Independence)
- always about the utterance situation itself. (Nondisplaceability)
- not propositional and can be hard to pin down (Descriptive ineffability)
- performative in that the very act of utterance conveys the meaning (Immediacy)
- strengthened when repeated without redundancy (Repeatability)

We have discussed how our proposal captures Immediacy and Repeatability. The remaining properties are discussed below.

- Independence holds due to our assumption that w and i are conditionally independent given u, which is generally the case. However, sometimes this assumption might fail to hold. Then we use the most general formula $L_0(w,i \mid u) \propto \Pr(w,i) \cdot [\![u]\!](w) \cdot S_0(u \mid [\![u]\!], w, i)$, which allows for descriptive and indexical meanings to interact with each other.

- Nondisplaceability: Social meaning, represented as a production probability $S_0(u \mid i)$, is always about the utterance situation itself, since the persona i is always relative to the speaker of the utterance.
- Descriptive ineffability: social meaning is represented as a production probability $S_0(u \mid i)$, which is not propositional. It can be hard to pin down because it can be difficult to describe the high likelihood region(s) of this production probability.

5. Further discussion

Representing use-conditional meanings in terms of the stereotypical speaker S_0 is a natural extension to previous multi-dimensional semantic systems (e.g., Potts, 2007; Gutzmann, 2015).

As a concrete example, consider the following simplified reformulation of Potts's analysis of the expression *the damn dog*. This expression has a multi-dimensional meaning. On the one hand, it has a normal descriptive content **d** (a type *e* individual), which comes from $[\![\text{the dog}]\!]$. On the other, it also has an expressive content f, a function that updates/alters the context. Here the context is represented by an *expressive index* of the form $\mathbf{s}\,I\,\mathbf{d}$, where I is an *expressive interval*, i.e., a subset of $[-1,1]$ representing the set of possible attitudes of the speaker **s** towards **d**. The effect of f is to shrink the expressive interval I and ensure that it is a subset of $[-1,0]$, i.e., the speaker **s** holds negative attitudes towards the dog **d**.

Generalizing the expressive interval I to a probability distribution $p(i)$ over the speaker's possible attitude i towards the dog **d**, we can derive a probabilistic literal listener model based on (26b), as shown in (33).

(33) $L_0(i \mid \textit{damn}) \propto \Pr(i) \cdot S_0(\textit{damn} \mid i)$

We can see that, once $S_0(\textit{damn} \mid i)$ is specified, (33) will implicitly define a mapping from the input context $\Pr(i)$ to an updated context $L_0(i \mid \textit{damn})$, i.e., the expressive content of *the damn dog*. In other words, the expressive meaning of *the damn dog* can be represented as $S_0(\textit{damn} \mid i)$, a probabilistic use-conditional meaning.

Note that this example can be generalized to a fully compositional analysis of *damn*: its descriptive content is the identity function **id**, and its expressive meaning is represented as $\lambda k.S_0(\textit{damn} \mid i[k^d(\mathbf{id})])$. This expressive meaning has two main components. The first is $\lambda x.S_0(\textit{damn} \mid i[x])$, the probabilistic use-conditional meaning in (33) relativized to x, i.e., how likely a speaker will use *damn*, given that his/her attitude towards x is $i[x]$. Here x can be an individual (e.g., the dog **d** in the above example), a proposition (e.g., the fact that the speaker lost the key in *I lost the damn key*), etc. The second component specifies that x is determined by the scope of *damn*. Concretely, x is the result of feeding the descriptive content of the expression that *damn* takes scope over with the identity function as its argument, i.e., $k^d(\mathbf{id})$. For instance, when *damn* takes scope over the rest of the DP in *the damn dog*, i.e., the descriptive content of the expression that *damn* takes scope over would be $\lambda f.\mathbf{the}(f(\mathbf{dog}))$, feeding it with **id** will make x be $\mathbf{the}(\mathbf{dog})$ (i.e., the dog **d**). When *damn* takes scope over the rest of the sentence in *I lost the damn key* (schematically, damn(λf. I lost the (f key)), applying the same procedure makes x be the proposition that the speaker lost the key.

This probabilistic approach provides a principled way to concretely specify expressive meanings and explain their properties. For instance, when the expressive meaning of *damn* is represented as a function that shrinks expressive intervals, it can be hard and arbitrary to specify how much the function should shrink each interval. In contrast, when the expressive meaning is represented a production probability $S_0(damn \mid i)$, it is much easier to specify an intuitively plausible production probability or learn it from empirical data.

6. Conclusion

In this paper, we analyze social meaning as use-conditional meaning, and provide a formal analysis by extending the RSA framework. We show that such an analysis can well capture the properties social meaning shares with expressive meanings, and discuss how the extended probabilistic framework could model use-conditional meanings in general.

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Responding to negative assertions in Germanic: On *yes* and *no* in English, Dutch and Swedish[1]

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Abstract. This paper presents evidence from three acceptability judgement experiments that tested the acceptability of the response particles YES and NO in affirming and rejecting responses to negative assertions in three Germanic languages. The study shows that the acceptability of the particles differs between the three languages, but does not correlate with the availability of a dedicated rejecting particle like German *doch* in the particle system of a language. Furthermore, the experiments revealed that there is considerable inter-individual variation. The paper thus contributes to the ongoing exploration of inter-individual variability in the use and meaning of response particles, which was first explored experimentally for German by Claus, Meijer, Repp and Krifka (2017). The paper discusses current theories of response particles and offers a preliminary account of the findings in the anaphora account of Roelofsen and Farkas (2015).

Keywords: response particles, negation, inter-individual variation, acceptability experiments.

1. Introduction

Response particles like English *yes* and *no* may in principle fulfil two functions. On the one hand, they may affirm or reject the truth of the proposition that is expressed in a previous utterance (= the *antecedent*). YES[2]-type particles affirm the truth; NO-type particles reject it. On the other hand, the particles may indicate that the response to the previous utterance has positive or negative polarity. YES-type particles indicate positive polarity; NO-type particles indicate negative polarity. When the proposition expressed in the previous utterance has positive polarity, these functions result in the same response pattern, see (1)(a). However, when the proposition expressed in the previous utterance has negative polarity, these functions come apart, so that in principle either particle can be used to express the intended meaning, see (1)(b).

(1)		*Antecedent*	*Response:* She does.	*Response:* She doesn't.
	a.	Li dances.	YES = affirm; positive polarity	NO = reject; negative polarity
	b.	Li doesn't dance.	YES = positive polarity	NO = negative polarity
			NO = reject	YES = affirm

It has long been known that languages vary with respect to the preference of assigning one of the two functions to YES and NO (Pope, 1976; Jones, 1999), and that there also are particles

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[2] We are using small caps to refer to YES-type / NO-type response particles irrespective of the specific language. We are using italics to refer to English *yes* and *no*, and to the corresponding particles in other languages.

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that combine particular specifications of these functions. For instance, German and French have a dedicated particle for rejecting negative antecedents like the antecedent in (1)(b): doch/si *she does*. The early accounts of response particle systems assumed that languages choose between truth-based and polarity-based systems for the choice of YES vs. NO. However, in recent years it has become clear that a clean partition into truth-based vs. polarity-based systems is rare (Roelofsen and Farkas, 2015). Preferences for particles often are gradient rather than categorical, which was first observed in literature using single-speaker acceptability judgements (Holmberg, 2013, 2015; Krifka, 2013; Roelofsen and Farkas, 2015; Farkas and Roelofsen, 2018), and which was confirmed in experimental investigations with larger speaker groups for various languages (Brasoveanu, Farkas and Roelofsen, 2013; Meijer, Claus, Repp and Krifka, 2015; Claus et al., 2017; González-Fuente, Tubau, Espinal and Prieto, 2015; Goodhue and Wagner, 2015, 2018; Li, González-Fuente, Prieto and Espinal, 2016). Furthermore, experimental investigations on German (Meijer et al., 2015; Claus et al., 2017) have shown that some of the judgements in the theoretical literature are speaker-specific to the extent that a substantial number of participants in the experiments show the opposite acceptability patterns from those reported in the literature. Therefore, even the more fine-grained analyses that have been proposed to account for gradient judgements (Krifka, 2013; Roelofsen and Farkas, 2015; Farkas and Roelofsen, 2018) have been called into question with respect to details of the analyses. Other strands of theoretical analyses of response particles (Kramer and Rawlins, 2011; Holmberg, 2013, 2015) also have been shown to struggle with the kind of data observed in German (Claus et al., 2017).

The present paper addresses the issue of variation both from the perspective of inter-individual variation and from the perspective of cross-linguistic variation. It presents evidence from acceptability judgement experiments in three Germanic languages: UK English, Netherlands Dutch and Swedish Swedish. The experiments use the same method and materials (translation-equivalent, country localized) as Claus et al. (2017). The goal of the study is to find out if and how the three languages differ from German both in the main acceptability pattern for YES and NO across speakers, and in the individual variation. The languages under investigation have a good potential to shed further light on the meaning and use of response particles because two of them (Dutch and Swedish) have at least one dedicated response particle for rejections of negative antecedents, whereas the third does not (English). In view of the fact that Claus et al.'s (2017) findings differ substantially from what had been reported in the literature on German and on English, we might hypothesize that the difference might be related to the presence of the rejecting particle *doch* in German. Since Swedish has been claimed to show similar preference patterns as English (Holmberg, 2015) but has the rejecting particle *jo* in addition to YES and NO, a comparison of Swedish with English will be very informative regarding this issue.

The paper is organized as follows. Section 2 reviews recent theories of response particles and provides a more detailed discussion of one of them, viz. the anaphoric *feature account* by Roelofsen and Farkas (2015), and Farkas and Roelofsen (2018), as this account seems to be the most promising to explain the data to be presented in this paper. Section 3 discusses the previous empirical observations in the quantitative and non-quantitative theoretical literature on response particles in English, Dutch and German. Section 4 reports three acceptability judgement experiments on these three languages, and discusses the findings for each language. Section 5 discusses the overall results from a cross-linguistic point of view and offers a preliminary theoretical analysis of the findings.

2. Theories of response particles

Theories of response particles fall into two major types: anaphora and ellipsis theories. Note, however, that anaphora theories also have an elliptic component because in these theories it is assumed that there may be a response clause in addition to the response particle, which may be elided. The ellipsis theories by definition are also anaphoric because ellipsis is anaphoric.

2.1. Anaphora theories

Anaphora theories (Krifka, 2013; Roelofsen and Farkas, 2015; Farkas and Roelofsen, 2018) derive the meaning of the particles at the semantics-pragmatics interface. The particles are propositional anaphors or anaphoric operators that pick up a proposition that was introduced by the antecedent. Krifka (2013) proposes a bidirectional optimality theory account. In this account response particles pick up a propositional discourse referent (= *propDR*) that was introduced by the antecedent, and operate on it. YES affirms the propDR, whereas NO negates it. Negative antecedents like *Li doesn't dance* introduce both a negative propDR, $\bar{p}_{DR}$, (= the proposition that is denoted by the entire sentence) and a positive propDR, p_{DR}, (= the proposition that the negation takes scope over). Krifka assumes that p_{DR} is more salient in default contexts than $\bar{p}_{DR}$, arguably because we are usually more interested in what is the case rather than in what is not the case. In negative contexts, e.g. in contexts where *not dancing* is under discussion, $\bar{p}_{DR}$ is more salient than p_{DR}. Krifka proposes that response particles like all anaphoric expressions are sensitive to the salience of potential antecedents. He models this role of salience as an OT constraint which penalizes the use of anaphora that pick up less rather than more salient antecedents. For dialogues with negative antecedents, this results in the following preference pattern for YES and NO. In an affirming response to *Li didn't dance* in a default context, NO negates the more salient p_{DR}, whereas YES affirms the less salient $\bar{p}_{DR}$. So NO should be preferred. In a negative context, the preference pattern is reversed. In a rejecting response to *Li didn't dance* in a default context, NO negates the less salient $\bar{p}_{DR}$, whereas YES affirms the more salient p_{DR}. So YES should be preferred. Again, in a negative context, the preference pattern is reversed. Rejecting particles like German *doch* come with a presupposition concerning the availability of $\bar{p}_{DR}$ and p_{DR}, and the intended meaning of the response. They block particles with the same meaning, which is modelled as an OT constraint, but can be thought of as an instance of *Maximize presupposition* (Heim, 1991), see Claus et al. (2017). There are further OT constraints in this account that pertain to dispreferred conversational moves like disagreeing with an interlocutor, but we will not discuss them here.

Roelofsen and Farkas (2015; henceforth R&F) and Farkas and Roelofsen (2018; henceforth F&R) is an account where the anaphoric aspect comes in the shape of a set of presuppositional features. R&F propose that clauses contain a polarity head *Pol* that takes the TP as complement. Pol hosts the presuppositional features. Absolute presuppositional features presuppose that the polarity of the response clause is positive [+], or negative [−]. Relative presuppositional features presuppose that the polarity of the antecedent and the (elided) response clause is the same [AGREE], or different [REVERSE]. Response particles *realize* the features. Which particle realizes which feature(s) depends on language-specific *feature-mapping rules* (F&R, 2018). For instance, English and German map [+] and [AGREE] to YES, [−] and [REVERSE] to NO. This setup explains the two functions of response particles introduced in Section 1. German additionally maps the feature combination [+, REVERSE] to *doch*. Other languages might not map a certain feature to any particle. Furthermore, there are language-specific *realization rules*. On the one hand, this means that a language might require certain features to always be realized: if the respective presupposition is fulfilled, e.g. for [REVERSE], a particle must be used to express this meaning component. On the other hand, languages might have preferences for the realization of certain features. A language might map [+] and [AGREE] to YES and [−] and [REVERSE] to NO, but the realization of the absolute features might be preferred so that the feature combination [AGREE, −] preferably is realized by NO, although YES is also acceptable. These realization rules contribute to accounting for the observation that cross-linguistically, the preference patterns for the use of YES and NO are gradient rather than categorical.

According to R&F and F&R, there are further constraints that are relevant for the meaning and use of response particles. A universal markedness constraint is REALIZE MARKED FEATURES. A marked feature is for instance the absolute feature [−] because (arguably) sentences with negation are harder to process than sentences without negation. The relative feature [REVERSE] also is marked because disagreeing is dispreferred in conversation. Finally, [+] is marked if combined with [REVERSE] because the two features do not form a natural class. The markedness constraint says that marked features have higher realization needs: they need to be expressed. For the English dialogue in (1)(b) above, this predicts that in the affirming response, *yes* can be used because it realizes [AGREE] and *no* can be used because it realizes [−]. However, *no* should be preferred because it realizes a marked feature whereas *yes* does not. In the rejecting response, *yes* can be used because it realizes [+] and *no* can be used because it realizes [REVERSE]. Both particles should be equally acceptable because *no* realizes the marked feature [REVERSE] and *yes* realizes [+] in a [REVERSE] response, which makes [+] marked. In addition to the markedness constraint, there are the blocking constraints EXPRESSIVENESS (*Express feature content as much as possible*) and FREQUENCY (*Prefer the use of frequent forms*). The former constraint results in the preferred use of particles that express more features over particles that express fewer features. For instance, German *doch* expresses the feature combination [+, REVERSE], whereas *ja* and *nein* only express one feature each in a response to a negative antecedent. Therefore, *doch* blocks *ja* and *nein*. However, since *ja* and *nein* arguably are more frequent than *doch*, FREQUENCY tempers the blocking effect of *doch*, so that *ja* and *nein* are not completely unacceptable in [+, REVERSE] responses. Finally, there is the general pragmatic constraint AVOID AMBIGUITY, by which expressions that are perniciously ambiguous are to be avoided. As we already saw, both YES and NO qualify as perniciously ambiguous as responses to negative antecedents. All the constraints that F&R discuss operate in a stochastic optimality-theoretic framework (Boersma and Hayes, 2001), which is suitable to model certain micro-variations. In such a framework, constraints are ranked along a continuous scale and the relative ranking of constraints that are close to each other can be perturbed.

The two anaphora accounts were directly juxtaposed in the study by Claus et al. (2017) which forms the blueprint for the current study. Since the aim of the current study is to contribute to a systematic cross-linguistic investigation of the meaning and use of response particles, the experimental setup to be presented in Section 4 tests the acceptability of YES and NO in responses to negative antecedents also with respect to a potential influence of default vs. negative contexts (Krifka, 2013). Claus et al. did not find the predicted pattern for German, and the effects of context that were obtained were not relevant in a way that would fit Krifka's basic assumptions. Furthermore, Claus et al. highlighted that to account for the substantial inter-individual variation in German, one would have to assume that speakers differ with respect to which of the two propDRs that are introduced by a negative antecedent, p_{DR} or $\overline{p}_{DR}$, is more salient for them. Experimental evidence supporting this assumption is not yet available. As the current study did not find any effects of context whatsoever (see below), our theoretical discussion of the experiments in Section 5 will concentrate on the account by R&F and F&R.

2.2. Ellipsis theories

Ellipsis theories (Van Cranenbroek, 2004; Kramer and Rawlins, 2011; Holmberg, 2013, 2015; Servidio, 2014; Servidio, Bocci and Bianchi, 2018) derive the meaning of response particles syntactically. The particles are the remnant of an elliptic clause, which is elided under identity with the antecedent clause. The clause that is elided is usually the TP, and the head that licenses the ellipsis is *Pol* or a similar head. Typically Pol takes the TP as complement. The response particle occupies the head or specifier position of PolP (Kramer and Rawlins, 2011; Servidio et al., 2018), or a position in a higher phrase (Holmberg, 2015). The sentential negation is hosted in the elided part of the clause. In the accounts of Kramer and Rawlins (2011) and Holmberg (2015), the identity of the ellipsis site with the antecedent is mitigated via polarity-related interpretable vs. uninterpretable syntactic features of the particle, of the polarity head and of the sentential negation. For negative-polar syntactic objects, these features are negative. For positive-polar syntactic objects, these features may be positive or (depending on the theory), there might be no polarity feature. Several negative features in the clause enter a feature chain so that only one of the features is interpreted by the semantics. To gain a rough impression, consider a dialogue with a negative antecedent and an affirming response like (2)B/B'. Ellipsis is marked by strike-through. [uNeg] and [iNeg] stand for *uninterpretable* and *interpretable negation feature*, respectively. In the *no*-response in (2)B, the three [Neg] features form a feature chain. In the *yes*-response in (2)B', the particle and the Pol head have no syntactic polarity feature so no feature chain will be formed. In (2)B/B', the TP in the response is identical with the TP of the antecedent clause so it can be elided. Differences between languages arise from differences in the syntax of the negation (Holmberg, 2015).

(2) A: [$_{TP}$ Li did not dance]. B: No$_{[uNeg]}$ [$_{PolP}$ Pol$_{[uNeg]}$ ~~[$_{TP}$ Li did not$_{[iNeg]}$ dance]~~
B': Yes, [$_{PolP}$ Pol ~~[$_{TP}$ Li did not$_{[iNeg]}$ dance]~~

The details of the other ellipsis accounts are different. We do not have the space to discuss them here but note that e.g. Servidio et al. (2018) assume that the particles carry features that are similar to the presuppositional features in R&F's anaphoric account. Also note that it has been suggested that particles may have different syntactic properties depending on whether they are used as responses to questions vs. assertions. For instance, Holmberg (2015) assumes that English *yes* and *no* are remnants of ellipsis but when used as a response to an assertion, *yes* is a rejoinder like *true/right*, i.e. not a remnant. We cannot do justice to the ellipsis theories in this paper. We would like to point out, though, that these syntactic theories do not naturally lend themselves as an explanation for graded acceptability (see Claus et al., 2017). In these accounts, a structure is derived or it is not. In other words, a response may be grammatical or it may be ungrammatical. To account for something like 'medium' acceptability these accounts must be part of a model that also includes pragmatic or psycholinguistic factors. This is not the place to develop such a model.

3. Previous empirical observations on responses to negative assertions[3]

The empirical observations to be discussed in this section are summarized in Table 1. For English, the existing literature makes rather divergent empirical claims. We already heard that according to R&F, affirmations of negative assertions are best expressed by *no* whereas rejections can be realized equally well by both *yes* and *no*. Krifka (2013) assumes that in default contexts, affirmations of negative assertions are best expressed by *no*, and rejections by *yes*. In negative contexts, affirmations of negative assertions are best expressed by *yes*, and rejections by *no* because of the altered salience of the propDRs introduced by the negative antecedent. Kramer and Rawlins (2011) assume that in responses to negative antecedents the meaning of *yes* and *no* gets neutralized, i.e. the two particles essentially mean the same and thus are equally acceptable both in affirming and in rejecting responses. Holmberg (2015) suggests that in affirmations, *no* is preferred but some speakers might also accept *yes*. For the latter, *yes* is a rejoinder like *true*, for others it is an ellipsis remnant. In rejections, *yes* is used. Previous experimental investigations (Brasoveanu et al., 2013) found for US English that in affirming responses, *no* is rated as more acceptable than *yes*. Goodhue and Wagner (2018) conducted an acceptability study on Canadian English that used the same design as Claus et al. (2017), experiment 2. They found that in affirming responses, *no* is clearly preferred over *yes*, but they found considerable variation for *yes*-affirmations (which they do not describe in detail). For rejections, *no* also seems to be more acceptable than *yes*, but the difference in acceptability between the two particles seems to be smaller. Taking all these observations together, we may hypothesize for our experiment on English (Exp. 1) that in affirming responses to negative assertions there is a preference for *no* over *yes*. Whether *yes* is acceptable at all or whether its acceptability is speaker-dependent is an open issue. If Krifka is right and context plays a role, negative contexts should produce a higher acceptability of *yes* over *no*. For rejections, we do not formulate a hypothesis because the previous empirical claims are very inconsistent.

Turning to Dutch (Netherlands), recall that in addition to YES and NO, i.e. *ja* and *nee*, Dutch has particles and particle combinations that like German *doch* are used in rejections of negative antecedents. Hoeksema (2006) lists *jawel, welles* and *toch wel*. For *nee,* Hoeksema suggests that it is affirming when used as a response to a negative antecedent but can be rejecting if it is followed by a positive response clause. *Ja* cannot be used as a response to negative assertions. As far as we know there has been no quantitative research for Dutch. Neither do we know anything about speaker variation. For our experiment on Dutch (Exp. 2), we hypothesize that in affirmations *nee* is acceptable whereas *ja* is not. In rejections, *nee* should also be acceptable because in the experimental materials the particle was always followed by a response clause. Furthermore, we hypothesize that *nee* is less acceptable in

[3] We do not discuss responses to negative polar questions because these typically are biased so that the response patterns for them are likely to be different.

rejections than in affirmations, because for rejections of negative assertions Dutch has specific particles so that some kind of blocking effect is likely to occur. As for speaker variation, we have no expectations.

For Swedish, Holmberg (2015) suggests that it has a robust polarity-based particle system. In other words, *ja* indicates that the response clause is positive and *nej* indicates that the response clause is negative. Swedish also has a dedicated particle for rejections of negative antecedents, *jo*. Holmberg reports that he is not aware of any speaker variation. For our experiment on Swedish (Exp. 3), we hypothesize that in affirmations, *nej* is acceptable whereas *ja* is not. In rejections, neither particle should be fully acceptable because the particle *jo* must be used. However, *ja* should still be more acceptable than *nej* because *ja* indicates positive polarity, i.e. fits the polarity of the response clause in rejections. There should be no speaker variation.

Table 1. Preference patterns for NO and YES reported in previous literature.

Response	Context	English	Dutch	Swedish
Affirmation *...hasn't*	Positive (Default)	NO > YES (*Krifka; R&F; EXP Brasoveanu et al.)* NO = YES (*Kramer & Rawlins)* NO; %YES (*Holmberg, EXP Goodhue & Wagner)*	NO *(Hoeksema)*	NO *(Holmberg)*
	Negative	YES > NO (*Krifka)*		
Rejection *...has*	Positive (Default)	YES > NO (*Krifka; Holmberg)* NO = YES (*R&F, Kramer & Rawlins)* NO > YES (*EXP Goodhue & Wagner(?))*	(NO) *(Hoeksema)*	– *(Holmberg)*
	Negative	NO > YES (*Krifka)*		

4. Acceptability judgement experiments

As already mentioned, the experiments in this study all used the same method and materials as experiment 2 in Claus et al. (2017) in order to ensure maximal comparability between the languages at issue. The translations contained small localizing adaptations for items that made reference to cultural aspects that did not fit a UK, Netherlands or Sweden context.

4.1. Experiment 1: English

Participants. 48 speakers[4] (18 to 65 years, *M* = 35.9; 26 female) participated in the experiment. They were native speakers of UK English and were recruited via *Prolific* (prolific.ac). Two speakers were from Wales, one speaker was from Scotland, the other speakers were from a variety of dialect regions in England. Six speakers used a second language with varying frequency (1 x Punjabi, 1 x Portuguese (several days per week); 1 x Welsh (several days per month); 2 x Spanish, 1 x Hungarian (less often)).

[4] This number is the number of participants that entered the statistical analysis. In all experiments, there were additional participants that did not complete the experiment or that did not respond to the verification statement correctly (see below), so they were excluded from the data analysis.

Materials & Design. There were 48 experimental items, 16 filler items, and one practice item. Each item started with a scene-setting passage followed by a dialogue between two interlocutors. The scene-setting passage introduced the interlocutors and conveyed information about the dialogue's context. It ended with a sentence that included an embedded question with positive or negative polarity, which was intended to induce a salient p_{DR} or a salient $\bar{p}_{DR}$, respectively (= factor CONTEXT).[5] The dialogue consisted of two turns: an assertion and a response to it. In the experimental items, the assertion had negative polarity. In the filler items, it had positive polarity. The response to the assertion always was composed of a response particle, i.e. *yes* or *no* (= factor PARTICLE), and a clause with positive or negative polarity, which made clear whether the response was affirming or rejecting (= factor RESPONSE CLAUSE). Thus, the experiment had a 2x2x2 design resulting in eight experimental conditions, see (3) for a sample item. The items were distributed over eight experimental lists in a Latin square design. The order of experimental items and filler items was pseudorandomized in six different ways.

(3) **Setting:** A couple of weeks ago Leroy and Heather asked their gardener to redo the back garden of their holiday home.

CONTEXT	*Negative*: Now they are chatting about what the gardener hasn't done yet.		
	Positive: Now they are chatting about what the gardener has done already.		
Dialogue:	Leroy:	The gardener hasn't sown the lawn yet. (= assertion)	
	Heather:	*No / Yes*,	*he hasn't / he has*
		PARTICLE	RESPONSE CLAUSE (*affirmation, rejection*)

All embedded questions, assertions, and response clauses were in present perfect tense. The embedded questions and the assertions contained a temporal adverb: *already* or *yet*, depending on the polarity of the sentence. The assertions were transitive sentences. The response clause contained a pronoun and VP ellipsis with or without negation. The sex of the interlocutors was balanced across items. To encourage the participants to read each item carefully, all items were followed by a true or false verification statement. The verification statement was either about the CONTEXT information (eight items), or about other information in the scene-setting passage or in the dialogue. True and false statements were equally distributed over all 64 items.

Procedure. The experiment was run as a web study. Each item was presented on a computer screen. The participants went through the experiment in a self-paced way per mouse-click. The setting, the assertion and the response appeared one by one, one under the other. Assertion and response were placed in a speech bubble, which was tagged by the name of the speaker. Then, a 7-point rating scale appeared, which consisted of a row of unnumbered bullets and the words *very unnatural / very natural* at the two ends of the row. The participants' task was to judge the naturalness and suitability of the response in the given dialogue and context by clicking on a bullet they considered fitting. They were instructed to take into account the information from the scene-setting passage, the assertion and the response. Furthermore, they were told that the response clause expressed the responding

[5] In half of the experimental items, that question established broad VP focus for the assertion (e.g., *[sown the lawn]$_F$* in (3)). In the other half, the embedded question was an object-focus question (e.g., *In the coffee break they are talking about [which animals] the vet has vaccinated already/hasn't vaccinated yet.*)

person's knowledge about the asserted state-of-affairs. After entering the judgement, the item and the rating scale disappeared from the screen. The verification statement appeared, for which the participants had to choose *false* or *true*. Only data from participants that made the correct choice 80% of the time entered the analysis.

Results. For the statistical analysis the row of bullets was coded as numbers on a rating scale from 1 (very unnatural) to 7 (very natural). We treated the scale as an ordinal scale. All analyses were conducted by using cumulative link mixed models for ordinal data (R package `ordinal`) with random intercepts for participants and items. Some models also contained random slopes for participants (see below). All factors were coded with orthogonal contrasts (1, -1). Table 2 shows the median ratings per condition. Figure 1 shows the proportion of ratings across participants and items, and collapsed over the factor CONTEXT as this factor did not yield any significant results. The results of the statistical analysis are given in Table 3. There were main effects of RESPONSE CLAUSE and of PARTICLE. Affirmations overall were rated as more acceptable than rejections, *no* overall was rated as more acceptable than *yes*. There also was an interaction of RESPONSE CLAUSE and PARTICLE, which was resolved by RESPONSE CLAUSE (see the lower part of Table 3). In affirmations, *no* was rated as more acceptable than *yes*. In rejections, *yes* was rated more acceptable than *no*.

Table 2: Median ratings per condition in Experiment 1 (English)

	RESPONSE CLAUSE	**PARTICLE**	**Median in negative / positive CONTEXT**
Affirmations	negative: *...hasn't*	*no*	7 / 7
		yes	2 / 2
Rejections	positive: *...has*	*no*	5 / 5
		yes	7 / 7

Table 3. Cumulative link mixed model results for Experiment 1 (English)

	Fixed effects	***β***	***SE***	***z***	***p***
Full data set	CONTEXT	-0.03	0.05	-0.70	n.s.
	RESPONSE CLAUSE	0.89	0.16	5.44	***
	PARTICLE	-1.05	0.14	-7.40	***
	CONTEXT × RESPONSE CLAUSE	0.009	0.05	0.20	n.s.
	CONTEXT × PARTICLE	-0.002	0.05	-0.05	n.s.
	RESPONSE CLAUSE × PARTICLE	3.46	0.24	14.33	***
	CONTEXT × RESPONSE CLAUSE × PARTICLE	-0.05	0.05	-1.06	n.s.
Affirmations	PARTICLE	-4.36	0.30	14.36	***
Rejections	PARTICLE	2.48	0.28	8.93	***

*Significance codes: *** p < .001, ** p< .01, * p < .05*

The best model that was fitted to the data contained random slopes for the interaction RESPONSE CLAUSE x PARTICLE per participant. Participants differed in the acceptability ratings for the two particles in affirmations vs. rejections. To explore this variation, we determined each participant's median ratings for affirming *no*- and *yes*-responses and for rejecting *no*- and *yes*-responses. The results are plotted in Figure 2. We are interpreting a median of ≥ 6 to signal that the participant found the respective particle acceptable and a median of ≤ 2 that the participant found the particle unacceptable. **For affirmations**, 47 participants (98%) rated

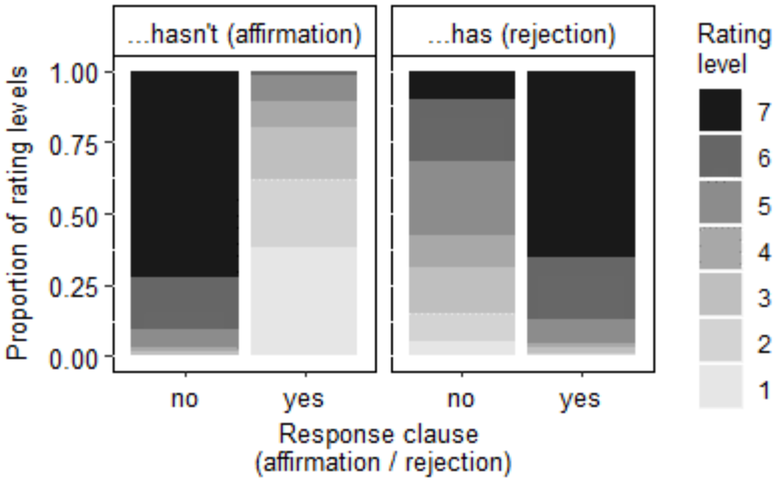

Figure 1. Experiment 1 (English): Proportions of ratings per rating level, ranging from 1 ('very unnatural') to 7 ('very natural') for the factors RESPONSE CLAUSE × PARTICLE.

no with a median of ≥ 6. No-one rated *yes* with a median of ≥ 6. All participants rated *no* with a higher median than *yes*. For 31 participants (65%) this difference was clear-cut, i.e. *no* had a median of ≥ 6 and *yes* a median of ≤ 2. **For rejections**, 42 participants (87.5%) rated *yes* with a median of ≥ 6. 13 participants (27%) rated *no* with a median of ≥ 6. In sum, 42 participants rated at least one of the particles with a median of ≥ 6, that is 6 participants (12.5%) did not rate any of the particles as acceptable. 43 participants (90%) rated *yes* with a higher rating than *no*. For 3 participants (6%) this difference was clear-cut, i.e. *yes* had a median of ≥ 6 and *no* a median of ≤ 2. 6 participants had the same rating for both particles (1 x 3, 1 x 5, 1 x 6, 2 x 7).

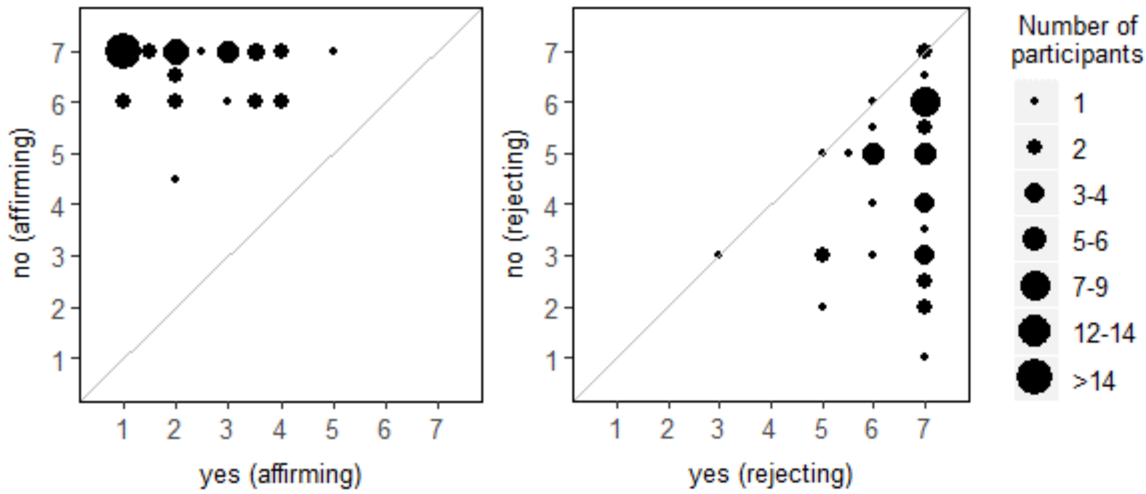

Figure 2a&b. Experiment 1 (English): Each participant's median rating for *yes* plotted against the corresponding median rating for *no* in affirmations (left) and rejections (right). Dot size indicates the number of participants who share the given pair of median ratings.

Discussion. Experiment 1 confirmed our hypothesis for affirmations of negative assertions. *No* clearly is more acceptable than *yes* (cf. Brasoveanu, et al., 2013; Krifka, 2013; Holmberg, 2015; R&F; Goodhue and Wagner, 2018). There was no effect of context: the predictions by Krifka (2013) on this issue were not confirmed. There was little speaker variation. For the majority of participants the difference in acceptability between the particles was substantial. Thus, the speaker variation reported in Holmberg (2015) could not be confirmed. For rejections, the experiment supported Krika's and Holmberg's claims. Overall, *yes* was preferred over *no*. However, there was unpredicted, considerable speaker variation. A quarter of the participants rated *no* as acceptable in rejections. We will evaluate these findings in the General Discussion.

4.2. Experiment 2: Dutch

Participants. 48 (16-53 years, M = 24.5; 16 female) participated in the experiment. They were native speakers of Dutch from a variety of dialect regions in the Netherlands. They were recruited via Prolific. 18 speakers used English on a daily basis, 18 used English several days per week, 6 used English several times per month. This essentially bilingual situation is typical of the Netherlands. English-language television programs are subtitled, and with the new media, English is pervasive throughout. See Section 5 for discussion. Some speakers used a third language: 6 speakers used German (1 x several times per week, 2 x several times per month, 3 x less often). One person used Cantonese on a daily basis. Some speakers used a third language several times per week in addition to Dutch and English: 1 x Croatian, 1 x Limburgish, 1 x Spanish, 1 x Vietnamese. One person used Japanese several times per month.

Results. See Experiment 1 for the data coding and statistical method. Table 4 shows the median ratings per condition. Figure 3 shows the proportion of ratings across participants and items, collapsed over CONTEXT as this factor did not yield significant results. The results of the statistical analysis are given in Table 5.

Table 4. Median ratings per condition in Experiment 2 (Dutch).

	RESPONSE CLAUSE	**PARTICLE**	**Median in negative / positive CONTEXT**
Affirmations	negative: ...*hasn't*	*nee*	6 / 6
		ja	5 / 5
Rejections	positive: ...*has*	*nee*	5 / 5
		ja	2 / 2

Table 5. Cumulative link mixed model results for Experiment 2 (Dutch).

	Fixed effects	β	***SE***	z	p
Full data set	CONTEXT	-0.01	0.04	-0.35	n.s.
	RESPONSE CLAUSE	-0.73	0.10	-7.14	***
	PARTICLE	-1.02	0.13	-7.62	***
	CONTEXT × RESPONSE CLAUSE	-0.05	0.04	-1.21	n.s.
	CONTEXT × PARTICLE	-0.01	0.04	-0.35	n.s.
	RESPONSE CLAUSE × PARTICLE	-0.36	0.04	-9.01	***
	CONTEXT × REPSONSE CLAUSE × PARTICLE	0.07	0.04	1.70	n.s.
Affirmations	PARTICLE	-0.54	0.06	-9.59	***
Rejections	PARTICLE	-1.87	0.25	-7.35	***

*Significance codes: *** p < .001, ** p< .01, * p < .05*

Figure 3. Experiment 2 (Dutch): Proportions of ratings per rating level, ranging from 1 ('very unnatural') to 7 ('very natural') for the factors RESPONSE CLAUSE × PARTICLE.

There were main effects of RESPONSE CLAUSE and of PARTICLE. Affirmations overall were rated as more acceptable than rejections, *nee* overall was rated as more acceptable than *ja*. There was an interaction of RESPONSE CLAUSE and PARTICLE, which was resolved by RESPONSE CLAUSE (lower part of Table 5). Both in affirmations and in rejections *nee* was rated as more acceptable than *ja,* but in rejections this difference was larger. Since there were convergence problems, models with the interaction of PARTICLE and RESPONSE CLAUSE as slopes for participants could not be tested. Therefore, models with the two factors as main effect were fitted. The analysis of the medians for *nee* and *ja* per participant revealed that there was great inter-individual variation. Figure 4 illustrates this. **For affirmations**, 30 participants (62.5%) rated *nee* with a median of ≥ 6. 16 participants (33%) rated *ja* with a median of ≥ 6. 6 participants had a median of ≥ 6 for both particles. In sum, 38 participants rated at least one of the particles with a median of ≥ 6, that is 10 participants (21%) did not rate any of the particles as acceptable. 29 speakers (60%) rated *nee* with a higher rating than *ja*. For 10 participants (21%) the difference was clear-cut, i.e. *no* had a median of ≥ 6 and *yes* a median of ≤ 2. 13 participants (27%) rated *ja* with a higher median than *nee*. For 2 participants this difference was clear-cut. 6 participants had the same rating for both particles (1 x 3, 1 x 5, 4 x 6). **For rejections**, 25 participants (52%) rated *nee* with a median of ≥ 6. 2 participants (5%) rated *ja* with a median of ≥ 6. In sum, 27 participants rated at least one of the particles with a median of ≥ 6, that is 21 participants (44%) did not rate any of the particles as acceptable. 38 participants (79%) rated *nee* with a higher median than *ja*. For 18 participants (37.5%) the difference was clear-cut. 6 participants (12.5%) rated *ja* with a higher median than *nee*. 4 participants had the same rating for both particles (1 x 2, 1 x 3, 1 x 3.5, 1 x 5.5).

Discussion. Experiment 2 overall confirmed our hypotheses for Dutch, which we formulated on the basis of Hoeksema (2006). *Nee* was more acceptable than *ja* both in affirmations and in rejections. However, there were clear differences between affirmations and rejections, and there was substantial speaker variation. In affirmations, *ja* seems to be much more of an alternative for *nee* than in rejections. In affirmations, a quarter of the participants rated *ja* with a higher rating than *nee*, although hardly anybody had a median rating of 7 for *ja*. That is *ja* did not reach the highest acceptability, which *nee* did. Still, *ja* was not totally unacceptable for most speakers, and thus apparently can be used as an affirming particle. In rejections, the difference between *nee* and *ja* was more substantial: *ja* is not acceptable as a rejecting particle. The results also indicate that there is a blocking effect of the rejecting particles (*jawel, toch wel, welles*): almost half of the participants found neither *nee* nor *ja* truly acceptable in rejections. There were no effects of context, i.e. Krifka's (2013) suggestions regarding context could not be confirmed for Dutch either.

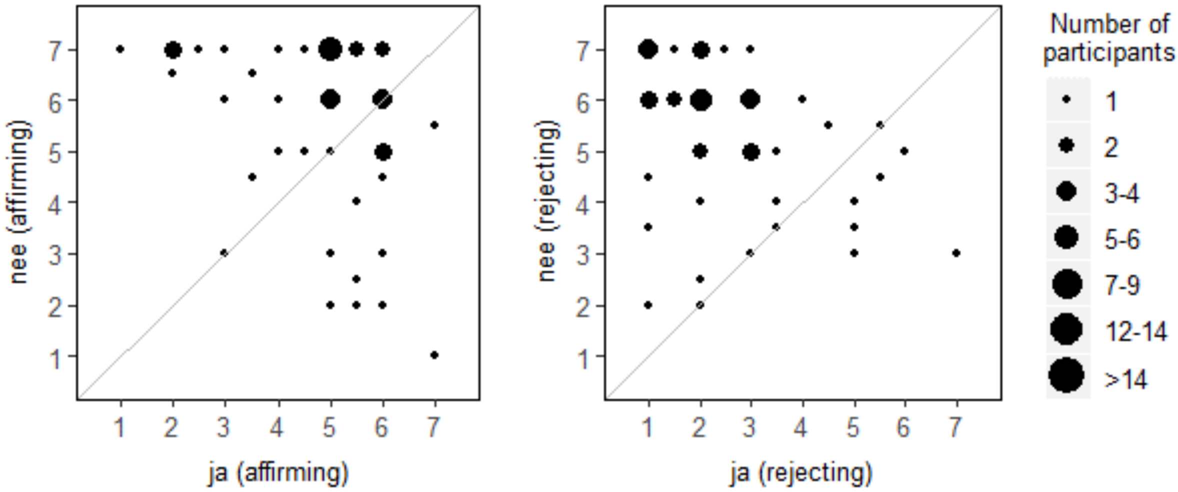

Figure 4a&b. Experiment 2 (Dutch): Each participant's median rating for *ja* plotted against the corresponding median rating for *nee* in affirmations (left) and rejections (right).

4.3. Experiment 3: Swedish

Participants. 32 speakers (17-49 years, M = 19.1; 5 female) participated in the experiment. They were native speakers of Swedish from a variety of dialect regions in Sweden. They were recruited via Prolific. 26 used English as a second language with varying degrees of frequency (9 x on a daily basis, 14 x several times per week, 3 x several times per month). One person used Russian and one person used Spanish several times per week. 6 speakers used a third language. Polish was used on a daily basis by one person in addition to daily English. One person used Arabic several times per month in addition to daily English. One person used French several times per month in addition to English, which was used several times per month. One person used German infrequently in addition to daily English. The two speakers that used Russian and Spanish as a second language used English as a third language on a daily basis. As in the Netherlands, bilingualism with English as a second language is pervasive in Sweden.

Results. See Experiment 1 for the data coding and statistical method. Table 6 shows the median ratings per condition. Figure 5 shows the proportion of ratings across participants and items, collapsed over CONTEXT as this factor did not yield significant results. The results of the statistical analysis are given in Table 7. There were main effects of RESPONSE CLAUSE and of PARTICLE. Affirmations overall were rated as more acceptable than rejections, *nej* overall was rated as more acceptable than *ja*. There was an interaction of RESPONSE CLAUSE and PARTICLE, which was resolved by RESPONSE CLAUSE. Both in affirmations and in rejections *nej* was rated as more acceptable than *ja* but in affirmations, the difference was larger.

Table 6. Median ratings per condition in Experiment 3 (Swedish)

	RESPONSE CLAUSE	PARTICLE	Median in negative / positive CONTEXT
Affirmations	negative: ...*hasn't*	*nej*	7 / 7
		ja	3 / 3
Rejections	positive: ...*has*	*nej*	4 / 4
		ja	2 / 2

Table 7. Cumulative link mixed model results for Experiment 2 (Dutch)

	Fixed effects	*β*	*SE*	*z*	*p*
Full data set	CONTEXT	-0.04	0.05	-0.80	n.s.
	RESPONSE CLAUSE	1.69	0.23	7.42	***
	PARTICLE	2.18	0.22	9.78	***
	CONTEXT × RESPONSE CLAUSE	-0.01	0.05	-0.19	n.s.
	CONTEXT × PARTICLE	0.02	0.05	0.46	n.s.
	RESPONSE CLAUSE × PARTICLE	0.58	0.29	2.01	*
	CONTEXT × RESPONSE CLAUSE × PARTICLE	0.08	0.05	1.50	n.s.
Affirmations	RESPONSE PARTICLE	-2.86	0.47	-6.09	***
Rejections	RESPONSE PARTICLE	-1.54	0.26	-6.00	***

*Significance codes: *** p < .001, ** p< .01, * p < .05*

Figure 5. Experiment 3 (Swedish): Proportions of ratings per rating level, ranging from 1 ('very unnatural') to 7 ('very natural') for the factors RESPONSE CLAUSE × PARTICLE.

The best model that was fitted to the data contained random slopes for the interaction response clause by response particles per participant, that is participants differed in the acceptability ratings for the two particles in the two speech acts. In order to explore this variation further, we determined each participant's median ratings for affirming *no*- and *yes*-responses and for rejecting *no*- and *yes*-responses. The results are plotted in Figures 6a&b. **For affirmations**, 24 participants (75%) rated *nej* with a median of ≥ 6. 4 participants (12.5) rated *ja* with a median of ≥ 6. 1 participant had a median of ≥ 6 for both particles. In sum, 27 participants rated at least one of the particles with a median of ≥ 6, that is 5 (16%) participants did not rate any of the particles as acceptable. 27 participants (84%) rated *nej* with a higher rating than *ja*. For 10 participants (31%) this difference was clear-cut, i.e. *no* had a median of ≥ 6 and *yes* a median of ≤ 2. 6 participants rated *ja* with a higher median than *nej*. **For rejections**, 10 participants (31%) rated *nej* with a median of ≥ 6. No-one rated *ja* with a median of ≥ 6. Thus, 22 participants (69%) did not rate any of the particles as acceptable. 25 participants (78%) rated *nej* with a higher rating than *ja*.

For 5 participants (16%) this difference was clear-cut. 1 participant rated *ja* with a higher median than *nej*. 6 participants had the same rating for both particles (2 x 1, 4 x 2).

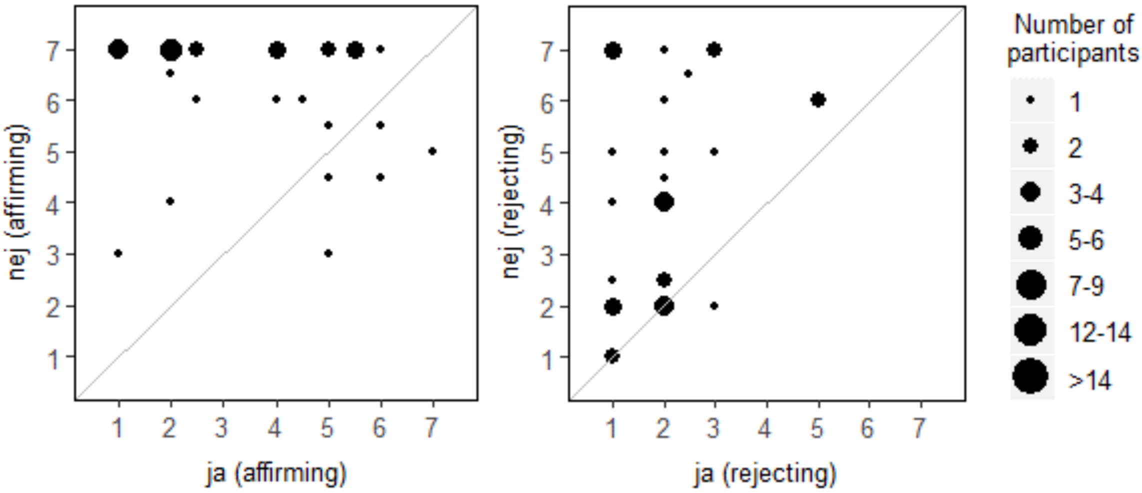

Figure 6. Experiment 3 (Swedish): Each participant's median rating for *ja* plotted against the corresponding median rating for *nej* in affirmations (left) and rejections (right).

Discussion. Experiment 3 overall confirmed our hypotheses for Swedish, which were based on Holmberg (2015), but some of the details differ. As hypothesized, *nej* was highly acceptable in affirmations, where it indicates the negative polarity of the response. *Ja* was not really acceptable – also as hypothesized. For rejections, we hypothesized that neither particle should be fully acceptable because Swedish has the rejecting particle *jo*. This hypothesis was confirmed for most but not for all speakers. A few speakers gave *nej* high acceptability ratings. We also hypothesized that *ja* might be more acceptable than *nej* because the former indicates positive polarity. This was not confirmed at all. *Ja* was generally rated to be unacceptable in rejections. There were no effects of context, i.e. Krifka's (2013) suggestions regarding context could not be confirmed for Swedish either.

5. General discussion

Table 8 summarizes the results for the three languages under investigation as well as experiment 2 in Claus et al. (2017) with an indication of the inter-individual variation. Recall that no effects were found for context so this factor is not part of the table.

We see that the overall acceptability pattern for the languages in Table 8 cannot be predicted from the availability of a dedicated rejecting particle in the particle system of a language – at least not for affirmations of negative assertions. For the majority of English, Dutch and Swedish speakers, NO is more acceptable in affirmations than YES is. German, which like Dutch and Swedish has a rejecting particle, shows the opposite distribution. As for the inter-individual variation in affirmations, the English participants were fairly uniform in their rating scores, whereas a considerable number of Swedish and especially Dutch participants showed an acceptability pattern that either was the opposite from the majority pattern or that did not differentiate between the particles. For many Dutch speakers, YES seems to be a viable alternative to NO. In German, there also is a considerable number of speakers who diverge from the majority pattern, which in this language is YES > NO.

Table 8: Summary of the acceptability patterns for NO and YES in experiments 1-3, with a comparison with German (Claus et al., 2017, exp. 2). Medians are in brackets. *Variation:* Percentage of participants who showed a certain pattern. Grey boxes: Percentage of participants who rated the less acceptable particle with a median ≥ 6; percentage of participants who rated both particles with a median < 6 (at least 5% of participants).

	Affirmations	***Variation***		**Rejections**	***Variation***	
English	NO (7) > YES (2)			YES (7) > NO (5)		
(n = 48)					NO = YES	12.5%
					NO ≥ 6	27%
					Y/N < 6	12.5%
Dutch	NO (6) > YES (5)	YES > NO	27%	NO (5) > YES (2)	YES > NO	12.5%
(n = 48)		YES = NO	12.5%		YES = NO	8%
		YES ≥ 6	33%			
		Y/N < 6	21%		Y/N < 6	44%
Swedish	NO (7) > YES (3)	YES > NO	19%	NO (4) > YES (2)		
(n = 48)					YES = NO	19%
		YES ≥ 6	12.5%			
		Y/N < 6	16%		Y/N < 6	69%
German	YES (6.5) > NO (5)	NO > YES	23%	NO (6) > YES (2)		
(n = 48)		NO = YES	12.5%		YES = NO	10%
(Claus et		NO ≥ 6	42%			
al., 2017)		Y/N < 6	6%		Y/N < 6	40%

Turning to rejections, English – the one language in our sample that does not have a dedicated rejecting particle – differs from the other three languages. For the majority of English speakers YES is more acceptable than NO. However, English also is the one language where the particle that overall is rated as the less acceptable one, still is considered by a substantial number of people to be a viable alternative: NO is accepted as a rejecting particle by around a third of the participants. In the other three languages, a substantial percentage of participants finds neither YES nor NO acceptable. This is not surprising because there is a dedicated particle for rejecting negative antecedents in these languages, which should reduce the acceptability of YES and NO. Still, there are differences between the languages. In Swedish, participants clearly dislike YES and NO in rejections, whereas Dutch and German speakers seem to be more lenient. Nevertheless, in all three languages NO is rated as more acceptable than YES. This is noteworthy considering that in English, which has the opposite pattern, NO also is fairly acceptable. These findings suggest that NO overall can be used for rejections, no matter what restrictions the response particle system otherwise might impose on the use of YES and NO.

At present, we have no answer concerning the considerable inter-individual variation that we found for all the languages under investigation. It is obvious that factors like prosody and gesture (e.g. head nods, head shakes), which cannot be tested in a written acceptability study, play an important role in the interpretation and production of responses in real-life conversation (cf. González-Fuente et al., 2015; Li et al., 2016). Furthermore, aspects like speaker intentions and expectations might also play a role. All these are issues for future research. Still, we note that the degree and kind of variation in the acceptability of the two particles differs between the languages. We have not investigated the statistical validity of these cross-linguistic differences because more data are required. We would like to point out, however, that the use of English in the daily life of Dutch and Swedish speakers cannot explain the entire variation: Swedish speakers are fairly consistent in their judgements whereas Dutch speakers are not.

Having pointed out the preliminary character of our data, we will nevertheless model the findings of our study in the framework that we consider to be the most promising account of response particles, viz. Roelofsen and Farkas (2015), and Farkas and Roelofsen (2018). This preliminary effort will give us a better understanding of the various parameters that may be involved in the meaning and use of response particles than the merely impressionistic interpretation above. For reasons of space we will not discuss German here, see F&R for a detailed discussion.

Recall from Section 2.1 that R&F assume that there are absolute polarity features, [−] and [+], as well as relative polarity features, [AGREE, REVERSE], feature-mapping rules and realization preferences, which are all needed to model the meaning and use of response particles. Furthermore, general pragmatic principles like the markedness constraint REALIZE MARKED FEATURES and the blocking constraints EXPRESSIVENESS and FREQUENCY are relevant. The realization preferences and the pragmatic principles are weighed against each other in a stochastic optimality-theoretic constraint ranking that differs between languages.

For English, we follow R&F in assuming that AGREE and [+] are mapped onto *yes,* whereas [REVERSE] and [−] are mapped onto *no*. Furthermore, we assume the constraint ranking in (4) with other constraints being ranked lower. This constraint ranking ensures that the particle realizing the absolute feature is preferred. In affirmations, this is *no* [−]. In rejections, this is *yes* [+]. Due to the constraint REALIZE MARKED FEATURES, *no* also is fairly acceptable in rejections because it realizes the marked feature [REVERSE]. We may also assume, with R&F, that [+] is marked if it is combined with [REVERSE]. This will give *yes* another 'boost' in rejections, i.e. make it the particle of choice.

(4) REALIZE ABSOLUTE FEATURES >> REALIZE MARKED FEATURES (English)

For Dutch we are assuming the same feature mapping as for English. Furthermore, we propose the constraint ranking in (5). The ranking of REALIZE MARKED FEATURES over REALIZE RELATIVE FEATURES explains why in affirmations, *nee* is more acceptable than *ja* for the majority of speakers: *nee* realizes marked [−]. The observation that *ja* is still fairly acceptable in affirmations is captured by REALIZE RELATIVE FEATURES, which is ranked below REALIZE MARKED FEATURES: *ja* realizes relative [AGREE]. For speakers with a different acceptability pattern this ranking might be perturbed. The details of this need to be worked out. The high ranking of EXPRESSIVENESS in Dutch ensures that the dedicated rejecting particles / particle combinations (*jawel, welles, toch wel*) are preferred in rejections of negative assertions: they realize a combination of features, [+, REVERSE], and not just one feature as *ja* or *nee* do. This assumption explains the observation that many speakers do not accept *ja* or *nee* in rejections. For some speakers the ranking of these constraints may be perturbed as they have high ratings for *ja* and *nee* in rejections.

(5) EXPRESSIVENESS >> REALIZE MARKED FEATURES >> REALIZE RELATIVE FEATURES (Dutch, Swedish)

For Swedish, which is quite similar to Dutch but with less inter-individual variation, we assume the same feature mapping rules and the same constraint ranking as for Dutch. It is interesting that the assumed blocking effect of EXPRESSIVENESS, which can explain the low acceptability of *ja* and *nee/nej* in rejections should be stronger for Swedish *jo* than for the Dutch rejecting particles. A potential explanation is that Swedish *jo* seems to be the one particle that is used in [+, REVERSE] responses, whereas in Dutch, there are various particles and particle combinations available. As a consequence, *jo* is likely to be more frequent than any of the Dutch particles, which might result in a stronger blocking effect. This can be captured in a high ranking of FREQUENCY.

The current study has corroborated the insight gained in earlier quantitative studies on response particles (esp. Claus et al., 2017), that speakers do not only assign the particles YES and NO graded acceptability in responses to negative assertions, but that they differ substantially in their judgements. We observed this for all three languages under investigation. This means that empirical claims about the meaning and use of response particles must be based on quantitative studies. What the precise source of the variation is is a matter of future research. Crucially, despite the inter-individual variation, languages also differ from each other. These differences can be captured in an account that takes established pragmatic principles into consideration and can explain graded acceptability as a consequence of the interaction of these principles.

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A closer look at the perceptual source in copy raising constructions[1]

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Abstract. Simple claims with the verb 'seem', as well as the specific sensory verbs, 'look', 'sound', etc., require the speaker to have some relevant kind of perceptual acquaintance (Pearson, 2013; Ninan, 2014). But different forms of these reports differ in their perceptual requirements. For example, the *copy raising* (CR) report, 'Tom seems like he's cooking' requires the speaker to have seen Tom, while its *expletive subject* (ES) variant, 'It seems like Tom is cooking', does not (Rogers, 1972; Asudeh and Toivonen, 2012). This contrast has led some theorists to hold that the matrix subject in CR constructions is uniformly interpreted as the *perceptual source* (p-source) (Asudeh and Toivonen, 2012; Rett and Hyams, 2014). Others, based on examples of CR reports that seem not to require perception of the referent of the matrix subject, have taken the p-source interpretation instead to be non-uniform across CR reports (Landau, 2011; Doran, 2015). We reconsider these theoretical approaches to copy raising in light of new experimental work probing the sensitivity of these requirements to the matrix verb, the embedded 'like'-clause, and the context. While we find some motivation for a non-uniform p-source analysis, it comes from importantly different cases than those others have relied on. Furthermore, our findings cast doubt on the prevalent assumption that the perceptual requirements of CR reports are to be captured solely by the presence or absence of the p-source interpretation. We suggest that the data motivating a non-uniform p-source view are better captured by an alternative approach, which makes use of a more minimal *evidential source* role, in place of the perceptual source role. We close by considering the relationship between English copy raising and evidential constructions cross-linguistically.

Keywords: copy raising, perception, acquaintance inference, evidentiality.

1. Introduction

Simple claims about appearances, as in (1a) and (2a), lead to the inference that the speaker has some kind of perceptual acquaintance (Pearson, 2013; Ninan, 2014). They are thus infelicitous, when conjoined with the denial of that acquaintance, as shown in (1b) and (2b).

(1) a. A: 'Tom **seems** like he's cooking.' $\rightsquigarrow$ A has perceived Tom
b. #'Tom seems like he's cooking, but I haven't perceived him.'

(2) a. A: 'The soup **smells** like it contains nutmeg.' $\rightsquigarrow$ A has smelled the soup
b. #'The soup smells like it contains nutmeg, but I haven't smelled it.'

Appearance claims, for our purposes, are claims with the main verbs 'seem', 'look', 'sound', 'smell', 'taste', and 'feel'. We'll be focused here on appearance reports of two syntactic forms: *copy raising* (CR) reports, as in (1), (2), and (3a), which have a substantive matrix subject and 'like'-clause that contains a co-referring pronoun; and *expletive subject* (ES) reports, as in (3b), which have a null 'it' matrix subject.

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(3) a. **Tom** seems like **he**'s cooking. Copy raising (CR)
b. **It** seems like Tom is cooking. Expletive subject (ES)

The syntactic form of an appearance report can make a difference to what kind of perception is required of the speaker. This has been compellingly illustrated by Asudeh and Toivonen (2012), with the following two cases:

(4) Ann and Ben walk into Tom's kitchen. Tom is at the stove doing something, but it's not clear exactly what.
a. Ann: 'It seems like Tom is cooking.' ES
b. Ann: 'Tom seems like he's cooking.' CR

(5) Ann and Ben walk into Tom's kitchen. They don't see him, but they see pots bubbling away on the stove, and ingredients on the counter, apparently waiting to be used.
a. Ann: 'It seems like Tom is cooking.' ES
b. #Ann: 'Tom seems like he's cooking.' CR
(modified from Asudeh and Toivonen, 2012: 331; see also Rogers, 1972)

While the copy raising report in (4b)/(5b) requires the speaker to perceive Tom, the expletive subject report in (4a)/(5a) only requires the speaker to perceive some scene relevant to whether he is cooking. So, the ES report is felicitous in the "absent cook" scenario in (5), though the CR report isn't.

This contrast leads Asudeh and Toivonen (2012) and Rett and Hyams (2014) to give what we will call *uniform perceptual source analyses* of copy raising constructions. As we will see in more detail in §2, on this view, all copy raising matrix subjects are interpreted as *perceptual source* (p-source), while expletive subject reports do not assign this role to any specific individual.

Other examples, however, cause trouble for this approach.

(6) A looks at the posted sheet of exam results and sees Bob's name towards the bottom.
a. A: 'It seems like Bob has failed the exam.'
b. A: 'Bob seems like he's failed the exam.'
(modified from Landau, 2011: 786; Heycock, 1994)

Cases like (6b), of CR reports that are acceptable even without perception of the subject, lead Landau (2011) and Doran (2015) to propose *non-uniform p-source analyses*, on which only some CR reports assign the p-source role to the matrix subject. However, they do not investigate why various CR reports get the interpretations that they do.

In this paper, we reassess the possible theoretical approaches to copy raising, in light of a more complete and systematic empirical picture of their perceptual requirements. In §3, we present experimental results probing the sensitivity of these requirements to the matrix verb, the embedded clause, and the context. In §4, we discuss the theoretical ramifications of these results. We show that a uniform p-source analysis is adequate for reports with verbs other than 'seem' and 'look', while a non-uniform p-source analysis is motivated for reports with these two verbs. However, such a resting place is theoretically unsatisfying. We therefore put forward, as an alternative, a revised uniform analysis, which rejects much of the previous reliance on the perceptual source role. Finally, in §5, we consider the relationship between appearance reports in English and evidential constructions cross-linguistically. But to begin, we turn in §2 to an overview of previous approaches to English copy raising.

2. Previous approaches to copy raising

2.1. Uniform perceptual source analyses

Previous approaches to the semantics of copy raising fall into two broad camps, when it comes to what they say about the status of the matrix subject. On one side, there are what we call *uniform perceptual source analyses*, which hold that all copy raising matrix subjects are interpreted as the perceptual source, or "what is perceived in a perceptual event or state" (Asudeh and Toivonen, 2012: 322). This approach, in essence, works into the semantics of copy raising and expletive subject reports the contrast that we saw above in the absent cook scenario. In other words, copy raising reports are analyzed so as to predict that the referent of the matrix subject must be perceived, whereas expletive subject reports are analyzed so as not to predict that any particular individual must be perceived. This may be achieved, for example, with the following two semantic values for 'seem'.

(7) a. $[\![\text{seem}_{\text{ES}}]\!] = \lambda p.\exists x[\text{perception of } x \text{ gives evidence that } p]$
b. $[\![\text{seem}_{\text{CR}}]\!] = \lambda x.\lambda P.[\text{perception of } x \text{ gives evidence that } P(x)]$

Analogous clauses can be given for the specific sensory verbs. For instance, for 'smell', we would simply replace "perception" with "olfactory perception."

For our purposes, Asudeh and Toivonen (2012) and Rett and Hyams (2014) can be interpreted as holding that all copy raising reports employ the clause in (7b). This yields the right result in the absent cook case: given that Tom — the referent of the subject — is not perceived in that scenario, the CR report is false, and for that reason infelicitous. By contrast, the ES report, employing (7a), is true, since there is something the perception of which gives evidence for the embedded claim, namely, the scene in the kitchen.

Some previous experimental work may seem to lend support to the uniform p-source analysis. Rett and Hyams (2014: §4.2) present results showing that, with the verbs 'seem', 'look', and 'sound', copy raising reports are highly unacceptable in "indirect contexts," or contexts in which the referent of the matrix subject isn't perceived. Chapman et al. (2015) also find that whether the speaker directly perceives the copy raising subject is highly correlated with the acceptability of the report, whereas the acceptability of expletive subject reports is not affected by perception. The findings in both studies, however, are a result of combining data from sentences with a variety of different embedded clauses. As we'll show in §3, this method can mask important differences in the perceptual requirements across different copy raising reports.

Asudeh and Toivonen (2017) develop the uniform p-source approach further, in response to some potential problem cases raised by Landau (2011) and Heycock (1994).

(8) B has just described to A the bizarre noises that B's car has been making.
A: 'Your car sounds like it needs tuning very badly.' (Asudeh and Toivonen, 2017: 57)

Acknowledging such cases, Asudeh and Toivonen note that the verb 'sound' allows for a "roundabout" interpretation, whereby the copy raising construction 'X sounds like...' is felicitous if the speaker has heard a *description* of X, even if they have not heard X itself. But, they hold, this does not mean that the subject is not a p-source. They write that "the sentence is acceptable because the speaker has received reported evidence about the engine of the car" (57). They thus advocate a broadening of our understanding of the p-source, such that something can be the p-source (for a 'sound'-claim) either by being auditorally perceived, or by being the subject of an auditorally-received report. This, they hold, also explains the infelicity, in the context from (8), of the CR report in (9).

(9) #A: 'Your mechanic sounds like he needs to tune your car.'

(9) is infelicitous because the mechanic is neither auditorally perceived nor the subject of a description that the speaker has heard. Thus, the mechanic cannot be the p-source, even on the broader understanding of that role.

Asudeh and Toivonen (2017) do not discuss potential counterexamples to the uniform p-source analysis with verbs other than 'sound'. We can, however, imagine them extending their solution to similar cases with 'look' and 'seem', such as the one given above in (6), repeated here with both verbs.

(10) A looks at the posted sheet of exam results and sees Bob's name towards the bottom.
  a. A: 'Bob seems like he's failed the exam.'
  b. A: 'Bob looks like he's failed the exam.'

Here, as in (8), one could salvage the uniform p-source analysis by holding that Bob can be the p-source because a representation of him, on the result sheet, is the source of evidence for the embedded claim.

Asudeh and Toivonen (2017)'s discussion is in fact neutral between the view we have just sketched, and a rather different way of broadening the p-source. We have suggested, on their behalf, that an individual can be a p-source not only by being perceived itself, but also by being the subject of a perceived description or representation. But one could instead hold that, in the appropriate context, a sentence with 'Bob', say, as the subject, could assign the p-source role not to Bob himself, but rather to a representation of Bob. This might involve, for instance, taking 'Bob' to metonymically refer to his name on the exam sheet.

However, as we'll see below, there are other challenge cases for the uniform p-source approach. Not all are plausibly captured by broadening our understanding of the p-source, in either of the ways that might work for (8) and (10).

2.2. Non-uniform perceptual source analyses

The second broad approach to copy raising allows for variability in the interpretation of the matrix subject: sometimes (as in the absent cook case), it is a perceptual source; other times (as in the car repair case), it is not. Thus, not all CR reports employ the clause given above in (7b), repeated here as (11a). Some instead employ the clause in (11b), which yields results equivalent to the ES version, though it is compositionally different.

(11) a. $[\![\text{seem}_{\text{CR}}]\!] = \lambda x.\lambda P.$[perception of x gives evidence that $P(x)$]
  b. $[\![\text{seem}_{\text{CR}'}]\!] = \lambda x.\lambda P.\exists y$[perception of y gives evidence that $P(x)$]

This is the approach taken by Landau (2011) and Doran (2015).[2] Landau (2011) is motivated by cases like (8) and (10), which we discussed above, in which copy raising reports are based on descriptions or representations of the subject. Doran (2015), however, acknowledging that such cases might be handled by a uniform p-source analysis (e.g. through metonymy), puts forward an interestingly different counterexample:

(12) A is a skilled musician with a highly trained ear. Through the thin walls of her apartment, she can hear her neighbor playing the guitar. The chords sound slightly off, like the guitar is missing a particular string.
A: 'The B string sounds like it's missing.' (Doran, 2015: 11)

Unlike the cases that Asudeh and Toivonen (2017) can account for by broadening the p-source, it is implausible, in (12), that a representation of the B string is heard, or that there is any kind of deferred of metonymic reference going on. It is thus hard to see how an advocate of the uniform p-source approach could insist that the B string is a p-source in this example. In §3 we will add yet more counterexamples to the uniform p-source approach.

Non-uniform p-source approaches are in a sense well-suited to account for the variable perceptual requirements of copy raising reports. However, they are in an important sense incomplete, without any story about which reports come along with the p-source interpretation of the subject, and which do not. Without this, it remains mysterious why CR reports are ever infelicitous due to lack of perception of the referent of the subject. Why can we not, in a scenario in which the subject isn't perceived, just use the non-p-source interpretation? Such a repair, however, seems unavailable. This is precisely what made the absent cook case so compelling.

Landau (2011: 790) briefly discusses this worry, and suggests that the claim that the speaker has perceived the referent of the subject is in fact just a strong implicature. He writes that "usage of CR (and not the expletive variant) implicates that the matrix subject does participate in the perceptual event. But this implicature can be overridden." And he follows up with some naturally-occurring examples of apparently non-p-source 'look'-claims. This, however, does not adequately address the worry. There is no doubt that some CR 'look'-reports are felicitous without perception of the subject. But this doesn't mean that the inference that the subject is perceived is only ever an implicature. If it were, then we would expect it also to be cancellable in the absent cook case. But it seems evidently not to be. Recall that we introduced the perceptual requirements of CR claims in §1 by showing that it is infelicitous (in at least some cases) to conjoin the given claim with the denial that one has had the relevant perceptual contact:

(13) #'Tom looks like he's cooking, but I haven't seen him.'

If the p-source requirement is just an implicature, then it remains to be explained why this implicature so stubbornly resists cancellation in certain cases, but is easily overridden in others.

To summarize, uniform p-source analyses, which take all CR matrix subjects to be interpreted as p-sources, are simple and systematic. However, they face a number of troubling counterexamples. Non-uniform p-source analyses can easily allow for such cases. But for them, it remains to determine more systematically which CR reports have p-source subjects and which

[2]Potsdam and Runner (2001) hold a related view, though not couched in terms of the perceptual source.

do not. We pick up with this task in §3, where we present experimental results testing the perceptual requirements of a wide range of CR reports. With that in hand, we will return, in §4, to reassess the theoretical options.

2.3. Note about labels

We have used the label "uniform p-source analysis" for analyses that take all copy raising matrix subjects to be p-sources; and "non-uniform p-source analysis" for those that take some copy raising matrix subjects to be p-sources, and others not. So far, we have been understanding these views broadly, to apply to reports with all the verbs of interest: 'seem', 'look', 'sound', 'smell', 'taste', and 'feel'. However, at points it will also be useful to consider more restricted uniform and non-uniform p-source approaches, as applied to reports with only one verb. So, a uniform p-source analysis of 'smell'-reports would have it that all CR reports with 'smell' have p-source matrix subjects. And such a view is compatible with a non-uniform p-source analysis of 'seem'-reports. (Landau (2011), for instance, endorses both of these views.)

3. Experimental work

The experimental work presented here has the goal of probing the perceptual requirements of copy raising reports, in a way that will give us a systematic picture of where the variability lies. We approach things one verb at a time, showing that 'seem', 'look', and 'sound' give rise to variable perceptual requirements in a way that 'smell', 'feel', and 'taste' do not. And furthermore, when there is variability across reports with the same verb, we aim to discern precisely what affects which copy raising reports give rise to the requirement that the subject be perceived, and which do not.

3.1. Overview of methods

We conducted a series of experiments testing the acceptability of copy raising reports in scenarios where the speaker did not perceive the matrix subject.[3] Each experiment has two conditions, a copy raising report and its expletive subject variant, both presented in the same scenario. Test subjects — self-reported native English speakers recruited through Amazon Mechanical Turk — were asked to rate the acceptability of the utterance in the given scenario, on a 7-point Likert scale. All experiments used a fully between-subjects design. Each experiment included a filler question, and two practice questions that also served as attention checks. A sample stimulus from an experiment with 'look' (used to confirm some data from Asudeh and Toivonen) is given in Fig. 1. The CR condition is shown. Other test subjects would see the same scenario, but with the ES variant ('It looks like Tom is cooking') instead.

[3]This paper discuses results of 15 experiments, six conducted in January 2018, and nine conducted in August 2018. The earlier experiments, summarized below in §3.2, are discussed in detail in (Rudolph, to appear). The later experiments, presented in §§3.3–3.5, are new to this paper; preregistration information can be found at `https://aspredicted.org/kk45r.pdf` and `https://aspredicted.org/8r2du.pdf`.

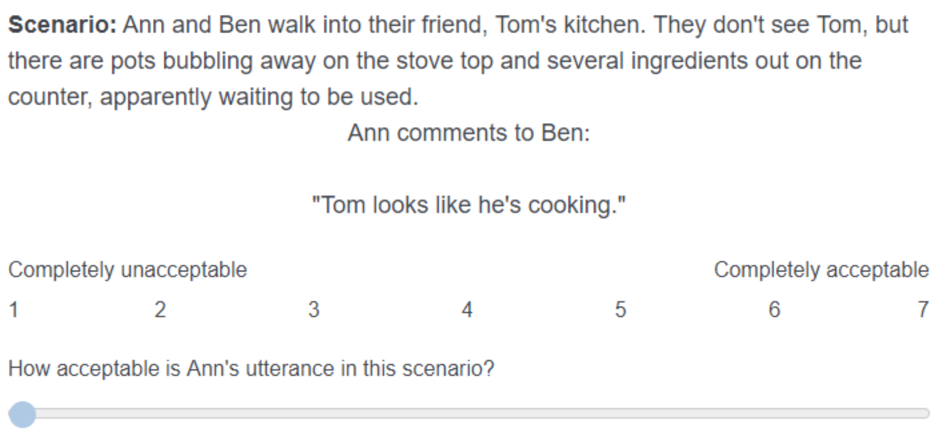

Figure 1: Sample experimental stimulus

If the expletive subject version was judged more acceptable than the copy raising one, to a statistically significant degree, then this is evidence that the CR report has the requirement that the subject be perceived. On the other hand, if the ES and CR reports were equally ranked, then that is evidence that the CR report does not have this requirement (as we assume that expletive subject reports certainly do not).

3.2. 'Seem'-reports and the importance of the embedded clause

Copy raising reports with 'seem' vary in their perceptual requirements. We saw in §2.2 that others have acknowledged this (Doran, 2015; Landau, 2011; Potsdam and Runner, 2001; Heycock, 1994). However, there has not been adequate investigation into what, systematically, affects when perception of the subject is required. We show here that a large class of cases where there is no such requirement has gone unnoticed. These are cases of CR reports embedding individual-level predications about the subject, as in (14) — which we might call the "absent experienced cook" variant on Asudeh and Toivonen's case.

(14) Ann and Ben walk into their friend, Tom's kitchen. They don't see Tom, but there are vegetables partially chopped on a cutting board, all perfectly even, and a roast cooling on the counter, delicately seasoned with fresh herbs.
  a. Ann: 'It seems like Tom is an experienced cook.'
  b. Ann: 'Tom seems like he's an experienced cook.'

The distinction between stage-level predicates (SLPs) and individual-level predicates (ILPs) goes back to Carlson (1977), and is, roughly, the distinction between predicates denoting more transient as opposed to more standing properties. One diagnostic, illustrated in (15), appeals to the interpretation of bare plural subjects of these predicates. When a stage-level predicate is predicated of a bare plural subject, an existential interpretation results, whereas when an individual-level predicate is predicated of a bare plural subject, a universal or generic interpretation results.

(15) a. Students are cooking. $\exists$: SLP
b. Students are upset. $\exists$: SLP
c. Students are experienced cooks. $\forall$: ILP
d. Students are well-organized. $\forall$: ILP

We found that in examples with embedded individual-level predicates, such as (14), (16), (17), and (18), both CR and ES reports were judged equally acceptable, even though the speaker did not perceive the referent of the subject (Fig. 2).[4]

(16) Sam and Sally glance into Beth's office while she's out at a meeting. They notice color-coded folders stacked neatly on the desk and a to-do list written on the whiteboard, with estimated completion times specified for each task.
a. Sam: 'It seems like Beth is well-organized.'
b. Sam: 'Beth seems like she's well-organized.'

(17) Karen and Mitch work together at a daycare center. Allie is a four-year-old who just started coming to the center. One day, Karen and Mitch are straightening up while the children eat their lunch in another room. Karen looks at the coloring project that Allie has been working on all morning, and notices all of the patterns neatly filled in with creative color combinations.
a. Karen: 'It seems like Allie enjoys arts and crafts.'
b. Karen: 'Allie seems like she enjoys arts and crafts.'

(18) Alice and Ed walk by their new neighbor, Claire's window one afternoon. They know Claire is out at work. Through the window, Alice sees a climbing tree and litter box. She also gets a clear whiff of cat smell through the open window.
a. Alice: 'It seems like Claire owns a cat.'
b. Alice: 'Claire seems like she owns a cat.'

However, in cases with embedded stage-level predicates, such as the original absent cook case, as well as the others given in (19) and (20), CR reports were ranked significantly less acceptable than the ES variants (Fig. 3).

(19) Sam and Sally glance into their co-worker Beth's office while she's out at a meeting. They see papers in a mess on her desk and crumpled on the floor. Sam knows that Beth usually keeps her office neat unless she's in an especially bad mood.
a. Sam: 'It seems like Beth is upset.'
b. #Sam: 'Beth seems like she's upset.'

(20) Allie is a five-year-old girl who is having trouble adjusting to kindergarten. Her teachers, Karen and Mitch, always encourage her to play outside during recess, but she usually stays inside crying to go home. One day during recess, Karen looks around the classroom and notices that Allie isn't there.
a. Karen: 'It seems like Allie is playing outside.'
b. #Karen: 'Allie seems like she's playing outside.'

[4]These results, other than the final one, with 'owns a cat', are presented in (Rudolph, to appear). For the pair with 'owns a cat', statistical tests showed no effect of report type on speakers' acceptability judgments: $F(1,79.3) = 1.31, p = .26; N = 86$. This experiment is included in the preregistration links given above.

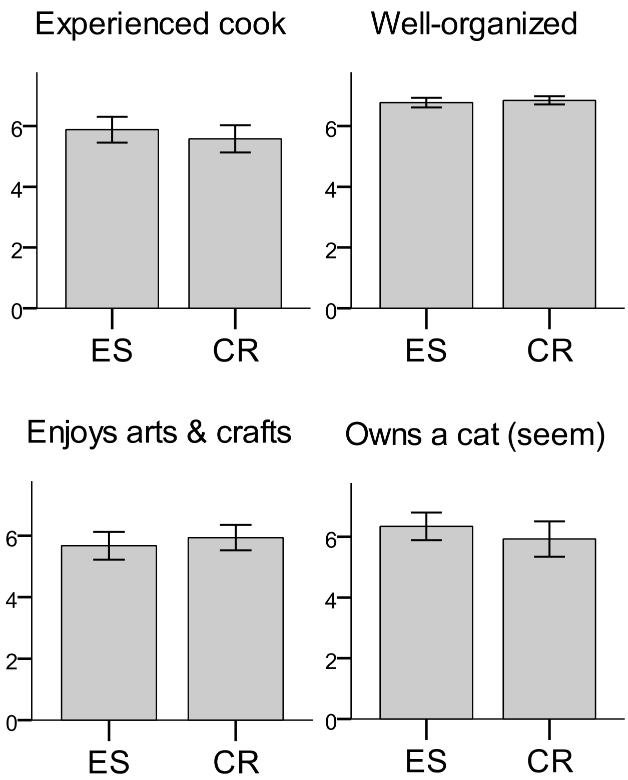

Figure 2: Mean ratings for ‘seem’-reports: ILPs

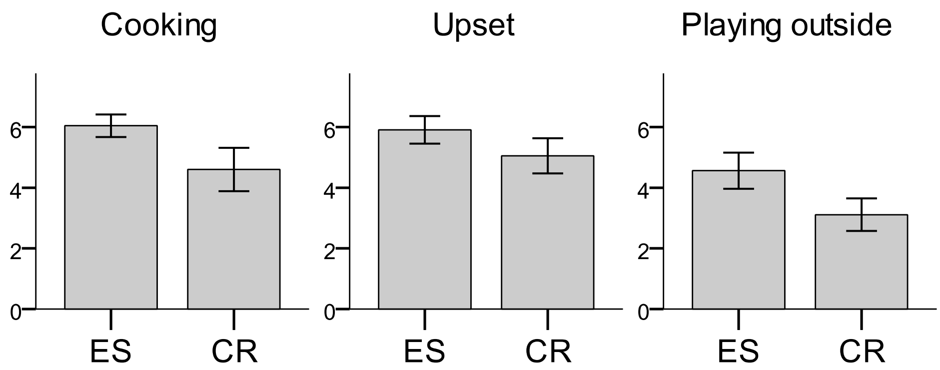

Figure 3: Mean ratings for ‘seem’-reports: SLPs

We thus experimentally confirm the data relied on by Asudeh and Toivonen (2012), while, however, undermining their generalization of the perceptual requirement from the absent cook case to all CR reports. Instead, we find a systematic sensitivity of the perceptual requirement to the clause embedded under ‘seem’: with stage-level predications behaving as Asudeh and Toivonen held, but individual-level predications being importantly different.

3.3. Extending to 'look'-reports?

Our initial prediction was that 'look'-reports would pattern with 'seem'-reports in terms of their perceptual requirements. We tested the original absent cook case, as well as the following 'look' variants on the 'seem' cases from above.

(21) Scenario as in (19).
  a. Sam: 'It looks like Beth is upset.'
  b. #Sam: 'Beth looks like she's upset.'

(22) Scenario as in (14).
  a. Ann: 'It looks like Tom is an experienced cook.'
  b. ?Ann: 'Tom looks like he's an experienced cook.'

(23) Scenario as in (16).
  a. Sam: 'It looks like Beth is well-organized.'
  b. Sam: 'Beth looks like she's well-organized.'

(24) Scenario as in (18).
  a. Alice: 'It looks like Claire owns a cat.'
  b. ?Alice: 'Claire looks like she owns a cat.'

In the SLP cases, the results with 'look' were as with 'seem', with ES reports rated significantly higher than CR ones (Fig. 4).[5] In the ILP cases, results were mixed (Fig. 5).[6] In several cases, the CR report was found to be significantly less acceptable than its ES variant, contrary to the prediction. However, the clear case of 'well-organized', where the two report types were equally highly rated, suggests that CR 'look'-reports can be flexible in their perceptual requirements in a similar way to 'seem'-reports.

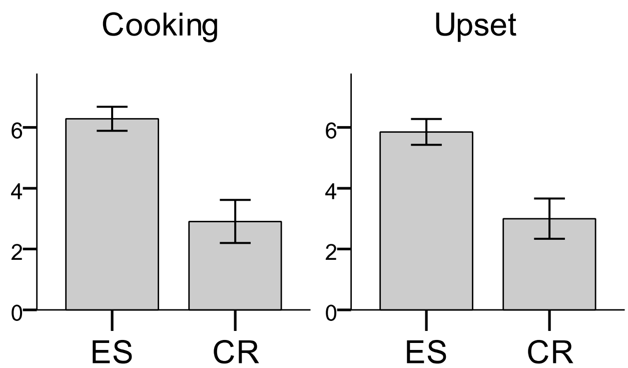

Figure 4: Mean ratings for 'look'-reports: SLPs

[5] 'cooking' ($N = 92$): $F(1, 67.08) = 70.54, p < .001$; 'upset' ($N = 117$): $F(1, 85.66) = 52.79, p < .001$.
[6] 'experienced cook' ($N = 128$): $F(1, 122.1) = 11.46, p = .001$; 'well-organized' ($N = 102$): $F(1, 99.22) = 2.27, p = .14$; 'owns a cat' ($N = 87$): $F(1, 84.44) = 7.39, p = .008$.

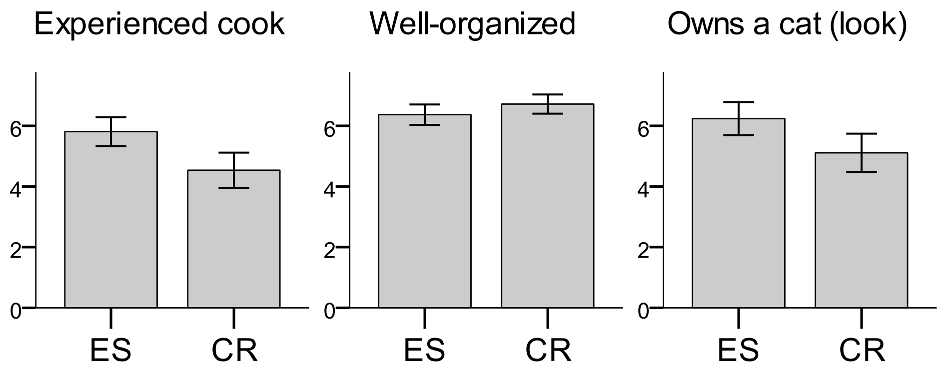

Figure 5: Mean ratings for ‘look’-reports: ILPs

3.4. Reports with ‘smell’, ‘taste’, and ‘feel’

Copy raising reports with ‘smell’, ‘taste’, and ‘feel’ invariably require perception of the referent of the matrix subject (Landau, 2011). This holds regardless of whether the embedded clause contains a stage-level predicate, as in (25), or an individual-level predicate, as in (26). We experimentally confirmed this with the ILP case (Fig. 6).[7]

(25) A and B snoop in their housemate C’s room after she’s left for work. They notice a strong scent of perfume, as though it was sprayed quite recently.
a. A: ‘It smells like C is wearing perfume today.’
b. #A: ‘C smells like she’s wearing perfume today.’

(26) Alice and Ed walk by their new neighbor, Claire’s window one afternoon. They know Claire is out at work. Through the crack in the window, Alice gets a clear whiff of cat smell.
a. Alice: ‘It smells like Claire owns a cat.’
b. #Alice: ‘Claire smells like she owns a cat.’

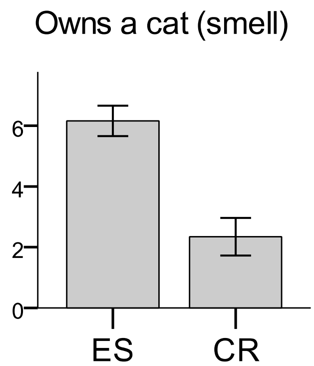

Figure 6: Mean rankings for ‘smell’-reports

[7] $F(1,87) = 81.8, p < .001; N = 89.$

Native speaker intuition confirms that ‘taste’ and ‘feel’ pattern with ‘smell’ in this regard. The following cases embed ILPs, but there is no doubt that the CR reports are infelicitous in the contexts described, where the subject isn’t perceived. By contrast, the ES reports are fine.

(27) Tom has invited A and B over for a home-cooked dinner. A takes a bite of mini-quiche appetizer and is impressed by the perfect consistency and delicate seasoning.
a. A: ‘It tastes like Tom is an experienced cook.’
b. #A: ‘Tom tastes like he’s an experienced cook.’

(28) A and B visit their neighbor, Naomi. A runs her hand over the armrest on the couch and notices ridges like those that would be made by scratching claws.
a. A: ‘It feels like Naomi has a cat.’
b. #A: ‘Naomi feels like she has a cat.’

3.5. ‘Sound’-reports: perception and representation

As we saw in §2.2, many theorists have put forward cases with ‘sound’ to show that not all CR reports require perception of the matrix subject. Here, we present experimental confirmation that in a context in which a ‘sound’-report is based on a description or representation, as in (30), the CR report does not require perception of the subject. However, in a context in which the report is based on auditory perception, as in (29), the CR report behaves just like those with ‘smell’, ‘taste’ and ‘feel’, being infelicitous without perception of the subject (Fig. 7). Both cases use the same embedded clause, with the ILP ‘owns a cat’.[8]

(29) Alice and Ed walk by their new neighbor, Claire’s window one afternoon. They know Claire is out at work. Alice hears what sounds like a faint meow coming from inside, followed by the sound of claws scratching against the floor.
a. Alice: ‘It sounds like Claire owns a cat.’
b. #Alice: ‘Claire sounds like she owns a cat.’

(30) Ed is telling Alice about his new neighbor, Claire. He mentions that he saw her carrying in a large climbing tower, as well as bags of kitty litter.
a. Alice: ‘It sounds like Claire owns a cat.’
b. Alice: ‘Claire sounds like she owns a cat.’

Note that the variability observed here with ‘sound’ is different from what we saw with ‘seem’ and ‘look’ above. There, we found CR reports with different embedded clauses having different perceptual requirements. Here, by contrast, we see the very same CR ‘sound’-reports, sometimes requiring perception of the subject, and sometimes not, based on the nature of the context in which the report is used.

In fact, representation-based uses of CR ‘sound’-reports seem to be acceptable, regardless of the embedded predicate, as is shown in (31), with the SLP ‘dancing ballet’.

[8] In the representational scenario: $F(1,94) = .258, p = .613$; $N = 96$. In the perceptual scenario: $F(1,53.1) = 44.44, p < .001$; $N = 74$.

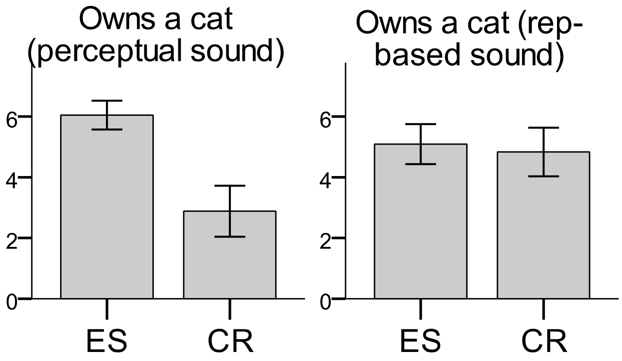

Figure 7: Mean rankings for 'sound'-reports

(31) B is looking through the window into a dance studio. Talking on the phone to A, he describes what he's observing.
a. A: 'It sounds like they're dancing ballet.'
b. A: 'They sound like they're dancing ballet.'

Note that 'seem' could be substituted in for 'sound' in the previous example. Thus, we should also recognize representation-based uses of 'seem', on which even copy raising reports with embedded SLPs do not require of perception of the subject. Reports with 'look' are arguably the same, with the caveat that the representation should be visually received, as in (32).

(32) A reads the office hours on their professor, Hannah's web-page and notices that the present time is listed.
a. A: 'It looks like Hannah is in the office now.'
b. A: 'Hannah looks like she's in the office now.'

3.6. Summary of empirical landscape

We have found three different sources of variability in the perceptual requirements of copy raising reports. First, there is variability due to the matrix verb. Copy raising reports with 'smell', 'taste', and 'feel' invariably require perception of the subject, whereas CR reports with 'seem', 'look', and 'sound' do not. (Of course, there is also a difference in what type of perception these verbs require; but we have been leaving that implicit.) Second, with 'sound', 'seem', and 'look', there is variability due to whether the report is perception-based or representation-based. In representation-based contexts, there is no requirement that the subject be perceived; in perception-based contexts there is always this requirement with 'sound', and sometimes with 'seem' and 'look'. Third, with 'seem' and (to a certain extent) 'look', there is variability due to the embedded clause. CR reports with embedded stage-level predicates tend to require perception of the matrix subject, whereas those with embedded individual-level predicates tend not to require this.[9]

[9] Further complication to the picture comes from cases with embedded predicates denoting some kind of absence, like 'missing', in Doran (2015)'s B string case in (12). This seems to be a distinct source of variability due to the embedded clause, not only with 'sound'-reports, but also with 'seem'- and 'look'-reports:
(i) A glances around the classroom and doesn't see Jim anywhere.

4. Revisiting theoretical approaches to copy raising

As we saw in §2, previous approaches to copy raising divide into two broad camps: uniform perceptual source analyses, which take all CR matrix subjects to be interpreted as perceptual sources, and thus to be necessarily perceived, if the report is to be felicitous; and non-uniform perceptual source analyses, which take some CR matrix subjects to be p-sources, and others not, thus allowing for some CR reports that are felicitous even without perception of the matrix subject.

4.1. Revisiting uniform p-source analyses

Already in §2, we saw some troubling counterexamples to a uniform p-source analysis; and the 'seem' and 'look' CR reports embedding individual-level predicates from §§3.2, 3.3 only make this kind of approach more difficult to maintain. While Asudeh and Toivonen (2017) may broaden their understanding of the p-source to account for representation-based cases, as we saw in §2.1, this move does not plausibly extend to cases like the absent experienced cook, in (14). Perceiving the product of Tom's cooking is not to perceive a representation or description of Tom; and nor is it plausible that when we say, 'Tom seems like he's an experienced cook', we somehow use 'Tom' to refer in a deferred way to the food that he cooked. We thus conclude that a general uniform p-source analysis is empirically inadequate. However, restricted uniform p-source analyses are adequate for 'smell', 'taste' and 'feel'. And a restricted uniform p-source analysis for 'sound' may also be fine, provided we take on board some version of Asudeh and Toivonen (2017)'s suggestion for representational cases.

4.2. Revisiting non-uniform p-source analyses

Non-uniform p-source analyses are empirically adequate, given our results. More specifically, our data support adopting non-uniform analyses at least for 'seem' and 'look'. Moreover, we have results in hand that allow us to be more systematic than previous non-uniform p-source theorists about which reports employ which versions of these verbs. We would hold that the non-p-source versions of these verbs are more often employed in CR reports, when these reports embed individual-level predicates.[10]

However, this is not an extremely theoretically satisfying place to land. We would, in effect, be saying that the two sentences in (33) have different semantic structures: the first with a p-source

a. A: 'Jim seems like he's absent.'
b. A: 'Jim looks like he's absent.'

Note that 'missing' and 'absent' are stage-level predicates; so this behavior is not captured by the observation that the perceptual requirement is lifted with embedded individual-level predicates.

The status of this kind of case with 'smell', 'taste', and 'feel' is somewhat unclear.

(ii) A tastes the soup and it's extremely bland, as though the cook forgot to include all the seasoning that the recipe called for.
? A: 'The salt tastes like it's missing.'

The CR report in (ii) is not completely unacceptable, by contrast with the 'taste' example from (27b). However, to the extent that it is acceptable, it might be heard as conveying that there is some salt that is tasted, but that is so faint it's barely detectable.

[10] See Rudolph (to appear: §5) for discussion of why this might be.

subject, employing clause (34a) (repeated from (11a)), and the second without, employing clause (34b) (repeated from (11b)).

(33) a. Tom seems like he's cooking.
b. Tom seems like he's an experienced cook.

(34) a. $[\![\text{seem}_{\text{CR}}]\!] = \lambda x.\lambda P.[\text{perception of } x \text{ gives evidence that } P(x)]$
b. $[\![\text{seem}_{\text{CR}'}]\!] = \lambda x.\lambda P.\exists y[\text{perception of } y \text{ gives evidence that } P(x)]$

Somewhat ironically, it is much more plausible that there are different semantic structures across perceptual and representational cases with 'seem' (or 'sound' or 'look'), like those we saw in §3.5. And yet the differences between those might be accommodated within a uniform p-source analysis. But the contrasts observed between SLP and ILP cases with 'seem' and 'look' do not seem to cry out for such an explanation — both kinds of CR reports are equally based on perception, and whatever difference there is between them seems not to come down to something about 'seem', but rather to something about the embedded clause. Put another way, the clearest problem for the uniform p-source approach, and so the clearest motivation for a non-uniform approach — assuming, as we will question in a moment, that it's the only alternative — comes from the ILP-embedding examples with 'seem' and 'look', like (33b). However, of all the potential problem cases for the uniform approach, these are the least plausibly encompassed by a non-uniform p-source view.

4.3. A new uniform analysis

A non-uniform perceptual source analysis is not the only alternative to an analysis that takes all CR reports to have p-source subjects. Another alternative is that *no* CR reports have p-source subjects. The ILP-embedding CR reports with 'seem' and 'look' that we've found may be elegantly captured with this new style of uniform analysis. The idea, also sketched in Rudolph (to appear: §6) for the case of 'seem', is that 'seem' and 'look' uniformly assign some role to their subjects, but it's not a role that builds in a perceptual requirement. Instead it's a more minimal role, which just requires that the subject individual be related in an appropriate way to the embedded claim. We have suggested that this role is the *evidential source* (e-source): the source of perceptual evidence. On such a view, all CR 'seem'-reports would employ the clause given in (35) (while CR 'look'-reports would employ an analogous one, restricted to visual perception).

(35) $[\![\text{seem}_{\text{CR}*}]\!] = \lambda x.\lambda P[x \text{ is the source of perceptual evidence that } P(x)]$

The crucial feature of the uniform e-source view, when it comes to capturing the observed variability in perceptual requirements, is that what it takes for an individual to be an e-source for some claim can vary depending on what that claim is. So, to return to our absent cook and absent experienced cook cases: what it takes for Tom to be an e-source for the claim that he's cooking may be more stringent than what it takes for Tom to be an e-source for the claim that he's an experienced cook. The difference between the SLP and ILP cases thus comes down to a difference between the properties denoted.

An open question for the e-source analysis for 'seem' and 'look' is how it accounts for differences between these two verbs. As we saw in §3.3, some ILP-embedding 'look'-reports retain the requirement of perceiving the subject much more strongly than 'seem'-reports with the same embedded predicates. The e-source analysis can explain some differences between these verbs, as it requires that the subject in a 'look'-report be the source of *visual* perceptual evidence, whereas the subject in a 'seem'-report must just be the source of (general) perceptual evidence. However, this difference does not readily explain the observed contrasts, given that in all of the scenarios considered, there was visual evidence for the embedded claim.

4.4. Summary of theoretical options

The empirical landscape we've mapped out is consistent with adopting only (restricted) uniform analyses for copy raising reports. However, we must adopt different kinds of uniform analyses for the different matrix verbs: uniform p-source analyses for 'smell', 'taste', 'feel', and 'sound'; and uniform e-source analyses for 'seem' and 'look'.[11]

Moreover, we might hold on to some of these theoretical choices, while questioning others. Let's consider two possible departures from the suggestions just given.

First, we might adopt a uniform e-source analysis for all appearance verbs. In this case, we would owe an explanation for why CR reports with 'smell', 'taste', and 'feel' always require perception of the matrix subject, whereas CR reports with 'look' and 'seem' do not. Within the e-source approach, the answer would have to appeal to a difference between, on the one hand, what it takes to be a source of olfactory, gustatory, or tactile evidence, and, on the other, what it takes to be a source of visual or general perceptual evidence. The availability of such an explanation is doubtful, however, given that a contrast persists between CR reports with 'seem' and 'smell', even in a scenario when the evidence is olfactory, as illustrated in (36) (and note that the ES 'smell'-report is fine).

(36) A walks into Tom's kitchen. Tom isn't there, but A can smell the soup he's been cooking and the balance of aromas suggests that it is expertly-made.
a. A: 'Tom seems like he's an experienced cook.'
b. #A: 'Tom smells like he's an experienced cook.'
c. A: 'It smells like Tom is an experienced cook.'

Second, if we doubt that representation-based CR reports with 'sound' can be adequately captured within a uniform p-source analysis, then we might opt for a non-uniform p-source analysis for 'sound'-reports. This would in fact interact with the other choices we've made. For if we adopt a non-uniform analysis for 'sound', then there might be some pressure to also adopt one for 'seem' and 'look', given that they too allow for representation-based uses. In that case, 'sound' would have both a p-source version (analogous to (34a)), and a version assigning no role to the subject (analogous to (34b)); and 'seem' and 'look' would have both e-source versions (like (35)), and a version assigning no role to the subject (again, like (34b)). The latter, ES-equivalent, versions would be specifically for claims made on the basis of descriptions or representations. This idea carries some plausibility, given connections between appearance

[11] A remaining question is how this accounts for cases like that of the missing guitar string, from Doran (2015). How much of a problem these cases are for a uniform p-source analysis seems to depend on whether the phenomenon is the same with 'taste' (say) as with 'look' or 'sound'. As mentioned in footnote 9, we remain somewhat unclear on this data.

language in English and evidential vocabulary cross-linguistically — a topic we discuss in the next section.

Our aim in this paper is not to come down definitively in favor of one final set of theoretical choices in this domain, but rather to map out some workable options, given the full empirical picture at hand.

5. Conclusion: copy raising and evidentiality

Many theorists have observed that appearance vocabulary in English conveys evidential information (Rett and Hyams, 2014; Chapman et al., 2015; Asudeh and Toivonen, 2017). We distinguish three facets of this evidentiality discussed in previous literature, and then close by adding a fourth of our own.

First, as we have discussed at length, at least some copy raising appearance reports convey that the speaker's evidence is from direct perception of the referent of the matrix subject.

Second, and independently, all of the appearance claims we've been discussing — of both copy raising and expletive subject forms — convey that the speaker has only indirect evidence for the embedded claim. When the truth of the embedded claim is completely evident, requiring no inference, then the bare assertion would be more appropriate than the appearance claim:

(37) A is standing in the pouring rain.
  a. A: 'It's raining.'
  b. ?A: 'It looks like it's raining.'

In this respect, appearance verbs behave somewhat analogously to epistemic 'must'.[12]

Third, some theorists have proposed that the reason why appearance claims give rise to perceptual requirements (or "acquaintance inferences") in the first place is that they communicate a commitment to direct evidentiality.[13] This is consistent with the previous point, as the suggestion here is that with an appearance report, we convey commitment to direct evidence for the claim (say) that Tom *looks* like he's cooking, whereas the previous point was that we convey that we have only indirect evidence for the claim *that he's cooking*.

But on top of this, the pattern that we have seen emerge with copy raising appearance reports fits within a cross-linguistic pattern of evidential constructions. Many languages have designated evidentials for claims based on perception in general, or specifically on visual perception; but none have designated evidentials for the specific senses of taste, smell, or touch (Aikhenvald, 2004). The split that we have found in this paper, between the behavior of the general perceptual 'seem', and the visual 'look', on one side, and the rest of the specific sensory verbs on the other side, conforms to this pattern. Furthermore, many languages have designated evidentials for claims based on hearsay or testimony. Representation-based 'sound'-reports seem to sig-

[12] See Chapman et al. (2015); von Fintel and Gillies (2010). For discussion of the connection between appearance vocabulary and epistemic modals see also Rudolph (2018).

[13] See e.g. Anand and Korotkova (2018), Muñoz (2018), Klempner (2018). For an alternative approach: Franzén (2018), Charlow (2018). Note that once our target is explaining the origins of these requirements, it actually becomes implausible to ever build anything about *perception* into the semantics of the vocabulary in question (Ninan, 2014). This is a critique of the perceptual source approach to copy raising that is independent of those raised earlier in this paper.

nal something similar in English. If this is right, then 'sound' has two importantly different evidential meanings — the one auditory perceptual, and the other testimonial.[14]

There is a great deal of variability in the perceptual requirements of appearance reports. But we find more order in the picture than there may initially seem to be, once we appreciate parallels between appearance constructions in English and evidentials more generally.

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[14] And 'look' and 'seem' may also have testimonial meanings, given that reports can be received visually as well as auditorally.

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Non-uniform plural inferences as scalar implicature[1]

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Abstract. Persian possesses a type of full root reduplication called *m-reduplication* that, when applied to a noun, results in a non-homogeneous plural interpretation; a reduplicated nominal is understood to refer to one or more objects in the denotation of the predicate denoted by the bare noun, as well as one or more objects that are similar in some respect to the bare noun. Although previous work has characterized m-reduplication as denoting a non-homogeneous plurality, evidence from non-upward-entailing environments and pragmatic contexts establishing speaker ignorance demonstrates that the non-homogeneous plural inference associated with reduplication is not entailed, but merely implicated. I provide an analysis of m-reduplication as involving *higher-order scalar implicature* (Spector, 2007), and further explain variation in the interpretation of m-reduplication in non-upward-entailing contexts. Finally, I unify the analysis of m-reduplication with that of the non-exhaustive expressions *-toka* and *-tari* in Japanese, providing a more satisfactory analysis of the latter than was present in previous work (Smith and Kobayashi, 2018).

Keywords: m-reduplication, Persian, higher-order scalar implicature, Japanese.

1. Introduction

Many languages, including Turkish, Persian, and Hindi, possess a type of full root reduplication called *m-reduplication*, that, when applied to a noun, results in a non-homogeneous plural interpretation; a reduplicated nominal is understood to refer to one or more objects in the denotation of the predicate denoted by the bare noun, as well as one or more objects that are similar in some respect to the bare noun. Focusing on examples from Persian, (1) is felicitous if Ali read gathered a bunch of objects, at least one of which is a flower, but others of which may be simply similar to flowers in the context, such as leaves or sticks.

(1) Ali gol mol jam' kard
Ali flower RED collect do.PST[2]
'Ali gathered flowers and the like.'

Previous work on m-reduplication mostly focuses on its morphophonology (Alderete et al., 1999; Ghaniabadi et al., 2006, a.o.), examining alternations in the first consonant of the reduplicant, which surfaces as [m] by default but as [p] when the first consonant of the base

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[2] This paper makes use of the following abbreviations: ACC: accusative case; CL: classifier; IMP: imperferctive aspect; NEG: negation; NOM: nominative case; PRS: present tense; PST: past tense; RED: reduplication; SG: singular; SUBJ: subjunctive mood

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is also [m]. Given the phonological nature of this work, the non-homogeneous plural meaning is simply taken for granted.

In one of the few works on the semantics of m-reduplication, Armoskaite and Kutlu (2013) examine m-reduplication in Turkish, characterizing it as a *similative plural*, where the plurality is understood to be non-uniform in the sense discussed by Nakanishi and Tomioka (2004) in the context of the Japanese associative plural *-tati*. In other words, the plurality denoted by m-reduplication contains objects in the set denoted by the non-reduplicated nominal, as well as objects that are similar, but not identical, to those objects. At first glance, this appears to be a good characterization of m-reduplication, and matches the intuitions native speakers have about (1) in Persian. However, the majority of Armoskaite & Kutlu's work is devoted to the range of categories to which m-reduplication may apply in Turkish, and otherwise takes the non-homogeneous plural inference for granted.

The goal of this work is to understand the *nature* of this non-homogeneous plural inference: is the existence of such a plurality *entailed* by m-reduplication, or is it merely *implicated*? In section 2 of this paper, I present an argument for the latter state of affairs: m-reduplicated nominals do *not* entail the existence of a non-homogeneous plurality. In particular, in non-upwaed-entailing semantic environments, as well as contexts establishing speaker ignorance, reduplication clearly includes uniform plurals, as well as singletons, in its denotation. I then propose an analysis of the non-homogeneous plural inference as derived via *higher-order scalar implicature* (Spector 2007): the inference arises via competition with an exhaustified version of the bare nominal. I also take into account variation in the interpretation of m-reduplication in non-upward-entailing and ignorance contexts, proposing different underlying meanings for the two groups of speakers examined while maintaining an implicature-based analysis for both. Finally, I show how the analysis extends naturally to the Japanese similative expressions *-toka* and *-tari*, which show the same sensitivity to monotonicity and interspeaker variation, and further demonstrate how the current analysis improves on previous analyses of these items (Smith and Kobayashi, 2017; 2018).

2. Non-upward-entailing environments

Although m-reduplication receives a non-uniform plural reading in upward-entailing environments like (1) above, there are a variety of contexts in which this reading is no longer found. These environments share the property of being non-upward-entailing: they are either downward-entailing or, in the case of questions, non-monotonic. I now turn to each of these environments in turn.

2.1. Negation

Negated sentences with m-reduplication provide the first clue that m-reduplicated sentences do not denote a non-uniform plurality. We find that (2), for instance, is true if Rostam did not read any number of books or, for some speakers, *anything similar to one*[3]

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[3] Where speakers vary in their judgments, I will put additional aspects of the interpretation permitted by speakers with a less restrictive interpretation of m-reduplication in parentheses.

(2) Rostam ketâb metâb na- xund
Rostam book RED NEG- read.PST
'Rostam didn't read books (or anything like that.)'

If *ketâb-metâb* denoted a plurality consisting of a book *and* at least one other book-like things, we would expect (2) to be interpreted as having the weaker interpretation that Rostam didn't read both a book and something similar.

2.2. The antecedent of a conditional

In the antecedent of a conditional, we again find that m-reduplication lacks the non-homogeneous plural reading attested in upward-entailing contexts.

(3) age ketâb metâb mi- xun -i, be man be- gu!
if book RED IMP- read.PRS-2.SG to 1.SG SUBJ- say.PRS
'If you read books (or something like that), tell me!'

In (3), the addressee may felicitously tell the speaker even if she has read only a single book, any number of books and nothing else, or, for some speakers, just some number of book-like things that are not themselves books, such as one or more magazines, in addition to a combination of books and book-like things. No speakers require that the addressee only tell the speaker if she reads at least one book in addition to a book-like thing.

2.3. Imperatives

In imperatives, m-reduplication once again fails to exhibit a non-homogeneous plural requirement. In (4), for instance, we observe that the speaker's request will be satisfied if the addressee eats at least one apple, or, for some speakers, just some apple-like fruit, such as an orange.

(4) sib mib bo- xor!
apple RED SUBJ - eat.PRS
'Eat an apple (or something like that)!'

In this case, too, if the non-homogeneous plural inference were part of the basic meaning of m-reduplication, we would expect to find that the addressee would need to eat both an apple *and* some apple-like fruit in order to comply with the imperative in (4), but no speaker judges this to be the case.

2.4. Polar questions

The final environment we will consider is polar questions. As with the other environments discussed above, m-reduplicated nominals are not interpreted as imposing a non-homogeneous plural requirement on the denotation of the nominal, as the following question answer pair demonstrates.

(5) a. sib mib xord -i?
apple RED eat.PST -2. SG
'Did you eat an apple (or something like that)?'

b. âre, ye/do tâ sib xord -am
yes, one/two CL apple eat.PST -1.SG
'Yes, I ate one/two apples.'

For some speakers, the following answer in (6) is also felicitous.

(6) âre, ye/do tâ porteghal xord -am
yes, one/two CL orange eat.PST -1.SG
'Yes, I ate one/two oranges.'

As with the other cases, we would expect to find the answers in (5b) and (6) to be infelicitous if the question in (5a) were interpreted to be asking whether the addressee consumed at least one apple and at least one apple-like thing.

2.5. Interim summary

Thus far, I have used non-upward-entailing semantic environments to demonstrate that m-reduplication does not entail the existence of a non-homogeneous plurality. This is very reminiscent of the behavior of English bare plurals, which exhibit a multiplicity inference in upward-entailing contexts, but which clearly possess singletons in their denotation when considered in the above contexts (Krifka, 2003; Spector, 2007; Zweig, 2009, a.o.). In the next section, I will provide further evidence for the lack of a non-homogeneous plural entailment with m-reduplication by using more pragmatic, rather than strictly semantic, considerations.

3. Speaker ignorance

Even in upward-entailing environments, it is possible to manipulate the pragmatic contexts in such a way that the non-homogeneous inference no longer arises. These are cases involving *speaker ignorance*. For example, consider the the speaker's statement in the context provided in (7). In keeping with the convention in previous examples, I include in parentheses aspects of the interpretation relevant to speakers with a less restrictive reading for m-reduplication.

(7) Context: you see Roya carrying a small lunchbox, in which she usually keeps an apple for an afternoon snack, but sometimes brings some other kind of fruit. You don't know exactly how many things she has in the box (and are not entirely sure what kind of fruit it is).
Sentence: Royâ sib mib dâr -e
Roya apple RED have.PRS -3.SG
'Roya has an apple (or something).'

Here, the speaker is not committed to Roya having more than one apple, nor are they committed to her having anything but apples. What's more, some speakers are not even committed to Roya specifically having an apple in the first place; for these speakers, she may just have some number of other kinds of fruits, such as oranges.

We find a parallel with the behavior of English bare plurals here as well. deSwart and Farkas (2010) note that bare plurals can be used in contexts in which some number of entities is known to exist, but for which there is not enough evidence to establish how many entities there are. In these cases involving ignorance, a plural may be used when the speaker does not know whether or not there is more than one object, just like in the m-reduplication case in (7).

(8) Inclusive reading of bare plurals with ignorance (deSwart and Farkas, 2010, 30)
  a. [Speaker walks into basement, and notices mouse droppings]
    Arghh, we have mice!
  b. [Speaker walks into unknown house, and notices toys littering the floor]
    There are children in this house.

All of this goes to show that the non-homogeneous plural inference observed in Persian m-reduplication is much like the multiplicity inference associated with English bare plurals: it is sensitive to the monotonicity of the semantic environment it is in, and also vanishes in more global pragmatic contexts establishing speaker ignorance, even in semantic environments in which the inference would otherwise be expected to arise. In the following section, I pursue an analysis further connecting m-reduplication to English bare plurals involving implicature.

4. Non-homogeneous plural inferences as higher-order scalar implicature

I propose that the non-homogeneous plural inference of m-reduplication be treated as an instance of scalar implicature. In particular, I propose that this involves *higher-order scalar implicature*, as proposed by Spector (2007) for deriving the multiplicity inference of English bare plurals. The basic idea behind a higher-order scalar implicature is that the implicature arises via the negation of an *already exhaustified* alternative. Due to the variation noted throughout the data discussed above, I provide two distinct but related analyses: the first will concern the more restrictive speakers, who do not permit m-reduplication to refer simply to the objects that are similar but not of the same variety as those denoted by the bare nominal, and the second will address the interpretation that less restrictive speakers obtain, in which m-reduplicated nominals may refer to those similar objects.

4.1. More restrictive speakers

For the more restrictive speakers, I analyze the unenriched meaning of m-reduplication as semantically identical to the unreduplicated bare nominal. Example (9a) demonstrates this analysis for reduplication as applied to the expression *book*, while (9b) provides a translation for *Mohsen read book-RED*.

(9) a. $[\![\text{book-RED}]\!] = [\![\text{book}]\!] = \lambda X.{*}Book(X)$

b. $[\![\text{Mohsen read book-RED}]\!] = \exists X[{*}Book(X)\ \&\ {*}Read(X)(m)]$

This captures the interpretation of m-reduplicated nominals in non-upward-entailing and ignorance contexts for more restrictive speakers, where an m-reduplicated nominal may refer simply to one or more books, but not to one or more objects similar to books.

Next, we need to derive the alternatives to an m-reduplicated nominal. By virtue of being more morphologically complex than the bare nominal (Katzir, 2007), reduplicated nominals have their bare nominal counterpart as an alternative. This is particularly appropriate for Persian, as bare nominals receive a number-neutral interpretation, and this will ultimately allow us to exclude cases where the subject, for instance, read only one or more books.

On top of this, I propose that sentences with m-reduplicated nominals specifically have as their alternative an *exhaustified* version of the sentence with the bare nominal. This will essentially amount to a focused version of the ssentence with a bare nominal, where the alternatives are contextually defined and excluded. This is similar to Spector's treatment of bare plurals, as well as to Sudo's (2014) analysis of disjunctions with conjunctive inferences in Japanese, where the required inferences are generated via competition with already exhaustified alternatives.

I formalize the notion of exhaustification in terms of Fox's (2007) *Exh* operator, defined in (10). IE stands for *innocently excludable*, and refers to the set of alternatives to a proposition p that may be negated without contradicting what is asserted by p.

(10) $Exh(A)(p) = p\ \&\ \forall q \in IE(A)(p): \neg q$

In words, Exh takes a proposition and a set of alternatives to that proposition, asserts the proposition and then negates all of the innocently excludable propositions in the set of alternatives to p.

Assuming a set of contextually relevant alternatives to (9a),[4] applying exhaustification to a sentence with the bare nominal, in this case book, results in (11a), with the innocently excludable alternatives given in (11b).

(11) a. $[\![\text{Exh(Mohsen read book)}]\!] = \exists X[{*}Book(X)\ \&\ {*}Read(X)(m)]\ \&\ \forall p \in IE(A)(p): \neg p$

b. $IE(A)(p) = \{$Mohsen read magazine, Mohsen read comic book, …$\}$

(11a) is interpreted to mean 'Mohsen read one or more books and he read nothing else that is contextually relevant.' Applying Exh to the sentence with m-reduplication then negates the alternative in (11a), resulting in (12).

4 Possibly restricted by a similarity requirement.

(12) $[\![\text{Exh(Mohsen read book-RED)}]\!] = \exists X[{*}\text{Book}(X) \ \& \ {*}\text{Read}(X)(m)] \ \&$
$\neg[\exists X[{*}\text{Book}(x) \ \& \ {*}\text{Read}(x)(m)] \ \& \ \forall p \in \text{IE}(A)(p) : \neg p]$

By deMorgan's Law, this reduces to the expression in (13).

(13) $\exists X[{*}\text{Book}(X) \ \& \ {*}\text{Read}(X)(m)] \ \& \ (\neg\exists X[{*}\text{Book}(X) \ \& \ {*}\text{Read}(X)(m)]$
$\text{v} \ \neg\forall p \in \text{IE}(A)(p) \text{: } \neg p]$

By disjunctive syllogism, we may eliminate the first disjunct within the second conjunct resulting from the application of Exh. Finally, by applying the equivalence between $\neg\forall p[\neg p]$ and $\exists p[p]$, we derive (14).

(14) $\exists X[{*}\text{Book}(X) \ \& \ {*}\text{Read}(X)(m)] \ \& \ \exists p \in \text{IE}(A)(p)\text{: } p$

This results in an interpretation where Mohsen read one or more books, and at least one of the contextually relevant alternatives is true. This is exactly the non-homogeneous plural inference we are looking for.

4.2 Less restrictive speakers

Recall that there are some speakers who permit less restrictive interpretations of m-reduplication in non-upward-entailing and ignorance contexts. Such speakers accept, for instance, cases where *ketâb metâb* 'book-RED' could refer to a single magazine, in addition to the interpretation where it refers to one or more books as interpreted by the more restrictive speakers.

One possibility is that these speakers have a different unenriched denotation for m-reduplication, such as the disjunctive one provided in (15).[5]

(15) $[\![\text{RED}]\!] = \lambda P.\ \lambda X.\ P(X) \text{ v } \exists Q[Q \sim P \ \& \ Q(X)]$

A translation for (9b) using this denotation of m-reduplication is provided in (16). Here, Mohsen is interpreted as either reading a book or something similar, but not identical to, a book.

(16) $[\![\text{Mohsen read book-RED}]\!] = \exists X[{*}\text{Book}(X) \text{ v } \exists Q[Q \sim \text{Book} \ \& \ {*}Q(X)] \ \& \ {*}\text{Read}(X)(m)]$

Although the non-homogeneous plural interpretation is more difficult to derive in this case, one possibility for deriving it is to follow Bowler's (2014) approach to conjunctive inferences associated with disjunction in Warlpiri and treat each disjunct as an alternative, while explicitly excluding a conjunctive alternative. Each disjunct will be exhaustified, yielding the set of alternatives in (17).

[5] The interpretation of the similarity relation ~ will have to be non-reflexive in order to ensure that Q is not identical to P.

(17) {P & ¬Q, Q & ¬P, P v Q}

Negating the innocently excludable alternatives, here (P & ¬Q) and (Q & ¬P) will result in the following in (18).

(18) (P v Q & ¬(P & ¬Q) & ¬{Q & ¬P)) = P & Q

This delivers a conjunctive inference, leading to an interpretation where, for instance, Mohsen reads both at least one book and at least one thing similar to a book. This is also the non-homogeneous plural reading we're interested in.

This raises the question of how to derive the required alternatives in the first place. One route would follow Sauerland et al.'s (2015) approach to the Japanese alternating conjunctive/disjunctive coordinator *ya* and simply associate the (exhaustified version of) each disjunct in the logical form of the sentence with RED. This raises an additional issue: one of these disjuncts does not correspond to any lexical item in the language, and is thus an *abstract* alternative. Such abstract alternatives may be independently motivated, as argued by Charlow (2016) and Buccola et al. (2018). This is thus not necessarily a problem for the current analysis. I will leave further investigation of this issue to future research.

5. Beyond Persian m-reduplication: Japanese *-toka* and *-tari*

Smith and Kobayashi (2017; 2018) investigated the Japanese morphemes *-toka* and *-tari*, which modify nominals and verb phrases, respectively. These bear a strong resemblance to m-reduplication in Persian, in that they are associated with a non-exhaustive inference in upward-entailing environments that disappears in non-upward-entailing contexts. The interpretation of these expressions in upward-entailing environments is given in (19) and (20), and an example of a downward-entailing environment eliminating the non-exhaustive inference is given in (21).

(19) Taro -toka -ga ki -ta
Taro -toka -NOM come -PST
'Taro and someone else came.'

(20) Taro -ga heya -o sooji si -tari si -ta
Taro -NOM room -ACC clean do -tari do -PST
'Taro cleaned his room and did other such things.'

(21) Taro -toka (Hanako -toka) -ga ki -tara, Yosuke-wa ocha -o das -u
Taro -toka Hanako -toka -NOM come -if Yosuke -TOP tea -ACC serve -PRS
'If Taro, Hanako, or someone like that comes, Yosuke will serve tea.'

Smith and Kobayashi's analysis makes use of a Hamblin-style alternative semantics (Hamblin 1973; Kratzer and Shimoyama 2002), according to which the alternatives generated by *-toka* and *-tari* are universally quantified in upward-entailing contexts but, essentially, existentially quantified in other contexts. This is similar to Davidson's (2013) analysis of general coordination in ASL.

This analysis runs into a few problems, however. First, use of the universal propositional quantifier leads to overly strong truth conditions in upward-entailing contexts; an expression with *-toka* or *-tari* in an upward-entailing environment is predicted to be true only when *all* of the contextually relevant alternatives are true. However, in reality, such sentences are judged true in upward-entailing contexts when *at least one* other alternative is true. Second, this analysis predicts very weak truth conditions for the cases when *-toka*/*-tari* appears in a downward-entailing environment; the prediction is that it should be possible for them to refer to an unmentioned alternative similar to the overtly mentioned expression in these contexts. While Ryoichiro Kobayashi is able to get this interpretation, other Japanese speakers disagree with this judgment.

One solution to these problems is to adopt an analysis for *-toka/-tari* that is basically identical to the one I have developed for Persian m-reduplication in this paper.[6] On this analysis, something like *Taro-toka* is interpreted as being identical to simply *Taro*, as (22) shows.

(22) $[\![\text{Taro-toka}]\!] = [\![\text{Taro}]\!] = \text{t}$

A sentence containing a *-toka/-tari* phrase will then be interpreted as identical to the sentence without the particle, as in (23).

(23) $[\![\text{Taro-toka-ga kita}]\!] = \text{Came(t)}$

We can then follow the same logic from section 4.1; sentences with *-toka* are associated with an exhaustified version of the sentence containing the bare nominal. This exhaustified alternative is shown in (24).

(24) $[\![\text{Exh(Taro-ga kita)}]\!] = \text{Came(t)} \ \& \ \forall p \in \text{IE(A)(p)} : \neg p$ IE(A) = {Hanako came, Jiro came, …}

We can then exhaustify the sentence with *-toka*, using the same applications of deMorgan's Law, disjunctive syllogism, and the equivalence between $\neg\forall p[\neg p]$ and $\exists p[p]$ we took advantage of before to generate the non-homogeneous plural inference of Persian m-reduplication.

(25)
$$\begin{aligned} [\![\text{Exh(Taro-toka-ga kita)}]\!] &= \text{Came(t)} \ \& \ \neg[\text{Came(t)} \ \& \ \forall p \in \text{IE(A)(p)}: \neg p] \\ &= \text{Came(t)} \ \& \ (\neg\text{Came(t)} \vee \neg\forall p \in \text{IE(A)(p)}: \neg p) \\ &= \text{Came(t)} \ \& \ \exists p \in \text{IE(A)(p)}: p \end{aligned}$$

This analysis solves the problems faced by Smith & Kobayashi's previous analysis. First, instead of universal quantification over the alternatives, we derive existential quantification over the alternatives, which correctly accounts for speaker's judgments in upward-entailing contexts. Second, in non-upward-entailing contexts, we no longer expect to derive the previous excessively weak reading of these expressions. Instead, we predict that the non-exhaustive reading goes away, resulting in cases where, for instance, only Taro came, rather than just someone similar to him in the context. While this matches the interpretation other

[6] I illustrate the analysis with *-toka*, but the same considerations hold for sentences with *-tari*.

Japanese speakers get, it is still possible to derive Ryoichiro Kobayashi's judgment for Smith and Kobayashi (2018) by proposing a disjunctive interpretation for *-toka/-tari* prior to exhaustification. It is therefore possible that there is interspeaker variation in the judgments about *-toka/-tari* in non-upward-entailing environments that mirrors the variation found in the judgments of Persian speakers about m-reduplication in the same environments.

6. Conclusion

In this paper, I examined the semantic properties of m-reduplication in Persian, and demonstrated that the non-homogeneous plural inference, taken for granted in other works, is not entailed by m-reduplication, but is rather implicated. I developed an analysis according to which this inference is generated via higher-order scalar implicature, taking into account interspeaker variation by proposing distinct underlying representations for the two populations of speakers. I then extended this analysis to the expressions *-toka* and *-tari* in Japanese, and showed that the analysis not only provides a unified framework for dealing with m-reduplication and these Japanese expressions, but also provides a more satisfactory account of the data discussed in Smith and Kobayashi (2017; 2018).

There is still much work to be done. First, the analysis of less restrictive speakers is a bit stipulative, and would do with more careful thinking. See Smith (in prep) for a more up to date analysis that reconciles the analyses of m-reduplication for more and less restrictive speakers, and puts the analysis of the judgments of less restrictive speakers on firmer footing. Second, it would be interesting to examine the behavior of m-reduplication in other languages in which it appears, such as Turkish and Hindi, to see if the judgments pattern the same as they do for Persian speakers. Third, it would be of interest to situate the behavior of these kinds of expressions in the context of other types of plurals crosslinguistically. While I have drawn an explicit comparison between the behavior of Persian m-reduplication and Japanese non-exhaustive particles to that of English bare plurals, it would be interesting to compare the behavior of these similative expressions to that of associative plurals, such as Japanese *tati* (Nakanishi and Tomioka, 2004, a.o.).

Finally, it has been brought to my attention that a connection with the semantics of plural personal pronouns may shed light on some of these issues.[7] Plural personal pronouns have an associative semantics: *we*, for instance, is typically interpreted to refer to the speaker and their associates. However, there are contexts, typically non-upward-entailing, in which singleton reference is possible, just like in the cases of m-reduplication and *-toka/-tari.* Example (26) demonstrates this possibility.

(26) Context: Sneaking into a museum to steal a priceless diamond. There are security cameras everywhere.

If we get spotted by a security camera, we'll go to jail.

Here, the interpretation is such that the group will go to jail if just one member of the group associated with the speaker is spotted by a security member, rather than the expected reading

[7] I thank Adrian Stegovec for bringing these facts to my attention.

where everyone in the group associated with the speaker needs to be spotted by a security camera. It is possible that an analysis along the lines of that pursued here could shed light on the issues raised by this case, and I leave an attempt to make such a connection to future research

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Introducing propositional discourse referents[1]

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Abstract. This paper addresses the question of which structures make propositions available for anaphoric reference, i.e., which structures introduce propositional discourse referents. I describe two current approaches to this question—one syntactic and one discursive—and then identify data which pose challenges to each approach. As an alternative, I offer a novel proposal: proposition-embedding operators introduce discourse referents for their propositional arguments. I show one way to formally model this generalization, using Update with Modal Centering (Bittner, 2011).

Keywords: propositional anaphora, discourse referent, small clause, adverb, raising, control.

1. Introduction

Karttunen (1969) is a systematic examination of which constructions license anaphoric reference to an individual, that is to say, in Karttunen's terms, which constructions introduce a *discourse referent* (dref). As Karttunen (1969) showed, not all indefinite noun phrases make an individual available for anaphoric reference, as exemplified by (1).[2]

(1) # Lucy doesn't have a car. *It* is blue. (cf. Karttunen, 1969: (4))

Karttunen (1969) concluded that NPs introduce drefs in sentences whose propositional content is "asserted, implied or presupposed by the speaker to be true" (p13). But as Krifka (2013) has shown, the same generalization does not hold for the introduction of propositional discourse referents (pdrefs), as demonstrated by (2).

(2) Lucy doesn't have a car. She tells people *that*, though. (cf. Krifka, 2013: (24))

The indefinite NP under the scope of sentential negation in (1) does not introduce a dref,[3] where the clause [Lucy has a car] under the scope of sentential negation in (2) *does* introduce a pdref which is available for reference by the anaphor *that* in the following sentence.

Given this discrepancy, a question arises as to the correct generalization for the introduction of pdrefs: which constructions license anaphoric reference to a proposition? This is the question which I will address in this paper.

There are two types of approaches to answering this question which are represented in the literature. For the remainder of this section, I will briefly introduce each approach, before challenging them both in the following sections.

[1] My thanks to James Collins, Edit Doron, Robin Karlin, Sarah Murray, Mats Rooth, Will Starr, John Whitman, and the audience at SuB23 for their advice. Any errors are my own.

[2] For purposes of illustration, sentences throughout will have (relevant) anaphors italicized and their (intended) antecedents underlined.

[3] Or its dref is otherwise inaccessible to the anaphor in the following sentence.

1.1. A syntactic approach

One response to the question of pdref introduction is to look to syntax. Krifka (2013) identifies the introduction of discourse referents with specific syntactic projections. In particular, TP and higher projections (like NegP for sentential negation) introduce propositional discourse referents, while vP introduces event discourse referents and ActP introduces speech act discourse referents. For example, Krifka (2013) provides the analysis in (3b) for the sentence in (3a).

(3) a. Ede didn't steal the cookie. (Krifka, 2013: (24))

b. $[_{\text{ActP}}$ ASSERT $[_{\text{NegP}}$ *Ede did-n't* $[_{\text{TP}}\ t_{\text{Ede}}\ t_{\text{did}}\ [_{\text{vP}}\ t_{\text{Ede}}\ t_{\text{steal}}$ *steal the cookie*$]]$
$\hookrightarrow d_{\text{speech act}}$ $\hookrightarrow d'_{\text{prop}}$ $\hookrightarrow d''_{\text{prop}}$ $\hookrightarrow d'''_{\text{event}}$

(Krifka, 2013: (22))

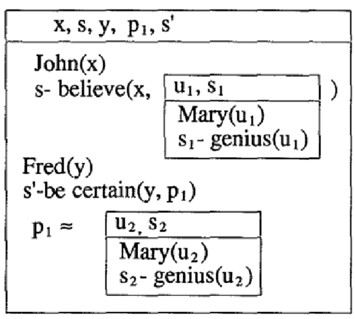
On this analysis, the TP introduces a pdref (d'') for its content—the proposition 'Ede stole the cookie'—, and NegP introduces a pdref (d') for its content—the proposition 'Ede didn't steal the cookie'. This is a necessary condition: whenever you have a certain structure, you have the associated discourse referent.

This analysis makes clear predictions about which constructions should license anaphoric reference to a proposition: constructions involving TP or higher projections should have pdrefs introduced for (and by) each of those structures. These predictions are easily tested, as we will see in Sections 2 & 3.

1.2. A discursive approach

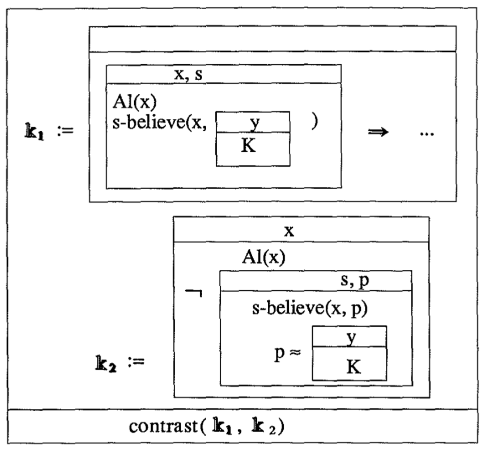
Another approach to the question of pdref introduction looks not to syntax but to discourse structure. Theories of discourse which make use of Discourse Representation Structures (DRSs) or elementary discourse units (EDUs) to model things like discourse relations (e.g., Asher, 1993; Carlson and Marcu, 2001; Asher et al., 2012; Hunter and Asher, 2016; Asher et al., 2017) can identify these structures with the introduction of pdrefs. For example, some implementations of Discourse Representation Theory (DRT) explicitly assign discourse referents for (sub)DRSs, as in p_1 in (4a), and Segmented DRT assigns a label to every (sub)SDRS, as in the $\Bbbk$s in (4b).

(4) a.



(Asher, 1993: 242)

b.



(Asher, 1993: 324)

It would be very natural to extend this pattern to all such discourse structures, and to associate a pdref with every (sub)DRS or EDU.

The predictions made by this type of approach for specific constructions are a bit harder to pin down than the syntactic approach, as it is not always clear what the appropriate representation for any given construction is, i.e., how many (sub)DRSs or EDUs make up a particular construction. That said, discourse annotation manuals like Carlson and Marcu (2001) & Asher et al. (2012) provide guidelines for the identification of EDUs, and sufficiently so that we can test the predictions of this discursive approach.

1.3. A brief note on methodology

To test the predictions made by each of these approaches, what we need is a method for evaluating the availability of a proposition (plausibly) introduced by some non-matrix material. In other words, we will have a structure like (5), and we are looking to see whether the proposition associated with some embedded content (q) is available for anaphoric reference. However, because the proposition denoted by the matrix clause (p) is an available antecedent, we need some way to rule that out as a competitor.

(5) $[_p \ldots [_{q?} \ldots]\,]$

In order to ensure that we are testing for q and not p, I will be using what I call a *Moore's frame*, inspired by Moore's paradox (Moore, 1993), the observation that sentences like (6) can never be uttered felicitously.

(6) It's raining but I don't believe it's raining.

I will use this type of frame so as to make a matrix-level interpretation—where the propositional anaphor is interpreted as referring to the matrix clause proposition—an unsuitable infelicitous interpretation. If the target sentence still has a felicitous interpretation, despite being in a Moore's frame, then I take that to be strong evidence that some non-matrix proposition has an associated pdref which is available for anaphoric reference. On the other hand, if the target sentence fails to have a felicitous interpretation, then I take that as evidence that there is no alternative non-matrix pdref available.

Throughout, I will use the propositional anaphor *that*, as it has the widest distribution (i.e., has the fewest selection restrictions) of the overt propositional anaphors (Snider, 2017a). I will rely on predicates which take propositional arguments—like *true*, *believe*, and *tell*—in order to diagnose the felicity of such propositional anaphors and as such, the presence of propositional discourse referents. Finally, sentences marked here as infelicitous may have felicitous variants which do involve anaphora, so long as that anaphora is to events or individuals as opposed to propositions; but considering that the felicity of other types of anaphora has no a priori bearing on the availability of propositional anaphora, and as such does not constitute counterevidence to any claims advanced here, I put such examples aside for present purposes.

2. Subclausal data

2.1. Small clause constructions

Small clause (SC) constructions involve a noun and a predicate, which together compose the small clause, following a verb. SC constructions have a number of different functions: they can introduce a predication, cause, result, or epistemic state, among other things (Wilder, 1991).

The syntactic approach makes a clear prediction here. Small clauses have been described in the literature as VPs or alternatively as special Predication Phrases (PrP; Bowers, 1993; Balazs, 2012). Both of these phrase types are structurally lower than TP, so we needn't decide between these two types of accounts, as both are equivalent for present purposes. On either of these analyses of small clauses, the syntactic approach predicts SCs not to introduce pdrefs. The discursive approach is less clear on this case, as small clauses aren't mentioned in Asher (1993) or Asher et al. (2012). Carlson and Marcu (2001) can be said to cover SCs only if SCs count as "clausal complements"; if they are not, then SCs should not constitute EDUs.

The prediction of the syntactic approach, at least, is borne out by most kinds of SC constructions:

(7) # Lucy wanted <u>her steak rare</u>, but *that*'s not true. (It's medium.) SEC. PRED.

(8) # Lucy made <u>Charlie angry</u>, but *that*'s not true. (He's happy.) CAUSATIVE

(9) # The rabbi pronounced <u>them married</u>, but *that*'s not true. (They're single.) RESULT

Even though (8) conveys the proposition 'Charlie was angry', that proposition does not have an associated pdref which is available for reference by the anaphor *that*.

But not all SC constructions behave the same way; the epistemic SC in (10) does seem to have an associated pdref, as the proposition it conveys is felicitously referred to by the anaphor.

(10) The rabbi considered <u>them married</u>, but *that*'s not true. (They're single.) EPISTEMIC

The small clause *them married* introduces a pdref in (10), even though no pdef is introduced for *them married* in (9). For either of the existing approaches to account for these data, the occurrences of *them married* must be represented differently in (9) & (10). For the discursive approach, *them married* must constitute an EDU in (10) but not in (9). For the syntactic approach, *them married* must be located within TP in (10) but not in (9). This is not *a priori* impossible, if (only) the former is a covert infinitive, for instance, but this would at least necessitate a reanalysis of our current understanding of the syntax of SC constructions. However, this reanalysis appears at best ad hoc, and at worst dangerously cyclical: if we don't have an independent reason to distinguish the structures of (9) & (10), then we end up defining a structure as a TP only when it licenses anaphora.

2.2. NP adverbial constructions

Constructions where an adverb acts as a modifier in the nominal domain also serve as an interesting testing ground for these approaches. The syntactic approach predicts that no modifier in the nominal domain should introduce a pdref, as this domain is below TP. The discursive approach stipulates that adverbial-modified clauses only constitute EDUs if those adverbs are temporal (Carlson and Marcu, 2001) or the clauses are elliptical (Asher et al., 2012), and so predicts that none of the following examples should introduce non-matrix pdrefs.

Most NP adverbials are well behaved in this regard, and don't introduce pdrefs:

(11) # Lucy lifted a fairly heavy box, but I don't believe *that*. DEGREE

(12) # Lucy lifted a surprisingly heavy box, but I don't believe *that*. EVALUATIVE

The proposition 'The box was heavy' isn't an available antecedent in either (11) or (12), even though both sentences entail that proposition; in both examples, the Moore's frame renders the utterance infelicitous, suggesting that no non-matrix proposition has an associated pdref. This is the case regardless of whether the agent-anchored adverb *surprisingly* in (12) is anchored to the speaker or to the subject (Lucy). In other words, no matter who was surprised by the heaviness of the box, that proposition isn't available for anaphoric reference.[4]

Epistemic adverbs, however, do allow for anaphoric reference to a non-matrix proposition:

(13) Lucy lifted a supposedly heavy box, but I don't believe *that*. EPISTEMIC

The felicity of (13) despite the Moore's frame indicates that there is a non-matrix proposition which is available for anaphoric reference. And the most natural reading of (13) is that the speaker believes that Lucy lifted a box which was supposedly heavy, but they don't believe the box was in fact heavy. In other words, the proposition 'the box was heavy' seems to be what was supposed and what is disbelieved.

Taken at face value, it would seem that the phrase *heavy box* would have to constitute a TP in (13)—but not in (11) or (12)—in order for the syntactic approach to account for these data.

One potential analysis that a defender of the syntactic approach might suggest is that in fact the sentence in (13) has a structure as in (14), making it equivalent to (15).

(14) [supposedly [$_{TP}$ Lucy lifted a t heavy box]], but I don't believe that.

(15) Supposedly, Lucy lifted a heavy box, but I don't believe that.

This movement of *supposedly* to a position structurally higher than TP would mean that it could introduce a pdref (in just the same way that NegP introduces a pdref in (3)), thus leaving a non-matrix proposition to deny. And in fact this analysis is very much in line with Cinque (1999), which locates epistemic adverbs higher than TP. If this analysis is correct, however, then (13) and (15) should be identical in meaning, where they seem not to be. To illustrate this difference in meaning, consider a context in which Lucy is known to be the strongest person alive, participating in some competition which involves box lifting. In such a competition, one might expect Lucy to be able to lift any box, but still disagree about the heaviness of any particular box. In such a context, in reporting on an event in which the participants lifted a

[4]The subject-anchored reading is perhaps the most plausible: 'Lucy lifted a heavy box, but I don't believe that she was surprised it was heavy'. Even this reading is unavailable, however.

small canvas box, a spectator might felicitously say (13), while an utterance of (15) would be strange.

This analysis also requires that any other inferences that one might understand from (13)—that the speaker believes ‘some box exists’, that the speaker believes ‘Lucy lifted that box’, that the speaker doesn’t believe ‘the box is heavy’—must all be implications, as the only asserted content is of the form *Supposedly p but I don’t believe p*.

The discursive approach, meanwhile, cannot account for (13), as it is neither temporal nor elliptical. Taken together, then, we have reason to believe that at least some material which on current analyses is below TP, or does not constitute an EDU, nevertheless introduces pdrefs.

3. Multiclausal data

In this section, we turn to raising and control constructions. Much ink has been spilled in the syntactic literature over the status of the complements of raising/control/ECM verbs, specifically over whether they are TPs or CPs. Fortunately for our purposes, these are equivalent under the syntactic approach as far as the introduction of pdrefs is concerned. Whether one of these clausal complements is a TP or a CP, it should in either case introduce a pdref (and thus be available for anaphoric reference). As a result, the syntactic approach predicts all of the examples in this section to allow for felicitous anaphoric reference to a proposition denoted by the embedded clause.

On the discursive approach, clausal complements are only considered to be EDUs if they are non-infinitival complements of cognitive or attribution verbs (Carlson and Marcu, 2001) or are infinitival purpose clauses (Asher et al., 2012). None of the following examples fit these criteria, so the discursive approach predicts none of the examples in this section to involve the introduction of a pdref for non-matrix content. As a result, all of the following examples are predicted to be infelicitous.

Both approaches predict uniformity across the class of raising and control constructions, and they predict exactly opposite behavior. Any data is guaranteed to contradict at least one of the approaches. As we will see, however, neither approach predicts the behavior observed here.

All subject raising constructions introduce pdrefs for their clausal complements, as in (16).

(16) <u>Lucy</u> seemed/appeared <u>to be at the party</u>, but *that* wasn’t true. (She was at home.) SUBJECT RAISING

(16) is felicitous and the proposition ‘Lucy was at the party’ is the natural antecedent to the anaphor *that*, so the complement clause does have an associated pdref. This is in line with the predictions of the syntactic approach, but contrary to those of the discursive approach.

No object control constructions, however, introduce pdrefs for their complements, as in (17).

(17) # Patty asked/begged <u>Lucy to be at the party</u>, but Linus didn’t believe *that*. (He thought she would stay home.) OBJECT CONTROL

(17) is infelicitous even with a follow-up attempting to coerce the intended interpretation, where the proposition associated with the complement clause is the antecedent of the anaphor *that*. This infelicity indicates that there is no available pdref for the complement clause. This behavior accords with the predictions of the discursive approach, but runs counter to those of the syntactic approach.

We already have in these two classes of constructions enough reason to doubt both the syntactic and discursive accounts, but examining the full paradigm gives us a clearer picture of when pdrefs are introduced. Having seen the behavior of subject raising and object control constructions, one might expect the introduction of pdrefs to fall along raising & control lines (where only the former introduce pdrefs), or similarly, along subject & object lines. As it turns out, however, neither class of constructions behaves uniformly. Both object raising & subject control constructions *sometimes* introduce pdrefs for their infinitive complements:

(18) Patty expected Lucy to be at the party, but Linus didn't believe *that*. (He thought she would stay home.) OBJECT RAISING

(19) # Patty wanted Lucy to be at the party, but Linus didn't believe *that*. (He thought she would stay home.) OBJECT RAISING

(20) Lucy claimed to be at the party, but *that* wasn't true. (She was home.) SUBJECT CONTROL

(21) # Lucy tried to be at the party, but *that* wasn't true. (She was home.) SUBJECT CONTROL

The object raising constructions in (18) & (19) constitute a minimal pair, the only difference being the choice of verb, *expect* vs. *want*. Only the former is felicitous, suggesting that only in (18) is a pdref introduced for the complement clause. Similarly, the subject control constructions in (20) & (21) constitute a minimal pair, differing only in their verbs, and only the former is felicitous. The complement of *claim* has an associated pdref, but the complement of *try* does not. The non-uniform behavior of these classes is a challenge for both the syntactic and discursive approaches, which predicted uniform behavior across all types of raising and control constructions.

These minimal pairs suggest that there is something about the embedding verbs themselves which is relevant for predicting the introduction of pdrefs, not just the structures they embed.

4. Generalization & Discussion

4.1. A new generalization

The data presented in the previous two sections challenge both the syntactic and discursive approaches to the introduction of propositional discourse referents. Both approaches focus on the structures themselves—be they syntactic or discourse structures—where the data presented above suggest that it is not a specific structure that is responsible for the introduction of pdrefs, nor is the discourse status of the respective propositions (Snider, 2017b). Instead, these data—in particular, the minimal pairs of the small clause-embedding verbs *consider* vs. *pronounce*, the raising verbs *expect* vs. *want*, and the control verbs *claim* vs. *try*—suggest that it is the embedders of those structures which is important in determining whether a pdref is introduced.

In particular, I argue that paying attention to the semantic types of the arguments that these verbs take is what is crucial to identifying the appropriate generalization. Many English verbs are quite flexible about what types of arguments they can take, and English also allows for fairly flexible type-shifting; nevertheless, note that verbs like *want* and *try* are incompatible with *that*-clause complements (standardly considered propositional), unlike *expect* and *claim*.

(22) Lucy expects that Charlie will come to the party.

(23) Lucy claims that Charlie will come to the party.

(24) * Lucy wants that Charlie will come to the party.

(25) * Lucy tries that Charlie will come to the party.

Note also that the arguments of *expect* and *want* can be described as being *true* or *false*—properties of propositions—while the arguments of *want* and *try* cannot.

(26) What Lucy expected is true/false.

(27) What Lucy claimed is true/false.

(28) * What Lucy wanted is true/false.

(29) * What Lucy tried is true/false.

Verbs like *expect* and *claim* take arguments whose semantic type is that of a proposition, while verbs like *want* and *try* do not. Only by paying attention to the semantic type of the arguments that these verbs take, in particular to which ones are compatible with propositional arguments, can we make the right generalization:

(30) Generalization: Operators which take propositional arguments introduce discourse referents for those arguments.

Thus far, we have only discussed the introduction of pdrefs for the propositions associated with embedded clauses, but as we can see in examples like (3), the matrix proposition also always has an associated pdref (even if that pdref is an infelicitous antecedent, as in a Moore's frame context). Ideally, we should want our generalization about the introduction of pdrefs to cover these cases as well, not just embedded clauses. Fortunately, we can capture the introduction of pdrefs in both matrix and embedded clauses if we consider sentential mood markers to themselves 'embed' the matrix proposition, following Bittner (2011). On this type of analysis, sentential mood markers take a (matrix) proposition as an argument and output instructions for what to do with that proposition (updating the common ground, partitioning the context set, etc.).

Having included sentential mood markers, we can expand the set of operators included within the generalization in (30). This set of operators includes, among other things, the declarative mood marker DECL, sentential negation NEG, and embedding verbs like *consider*, *seem*, *appear*, *expect*, and *claim*. For a more comprehensive survey of which operators are included (and excluded), see Snider (2017a).

4.2. Comparison with existing approaches

The new generalization proposed here makes reference to the semantic type of the arguments of various operators, and in that regard is a semantic approach to the question of pdref introduction. In that this generalization deals with combinatorics, it is also syntactic in nature; however, it also goes beyond the tools of syntax (syntactic category, movement/extraction type) and makes reference to descriptions which are semantic in nature. That said, there is nothing here which is fundamentally incompatible with either a syntactic or discursive approach, if the same behavior here could be predicted using the tools of those worlds. The challenge for those approaches would be in incorporating the insights gained here in a way that doesn't seem arbitrary or ad-hoc. Doing so might require reanalyzing theories of certain structures (e.g., small clause constructions), drawing subdivisions within existing classes of structures (e.g., subject control constructions), and/or extending theories to new paradigms (e.g., extending Cinque, 1999 on adverbs and Hacquard, 2011 on modals to all verbs).

The crucial difference between this generalization and those suggested by the existing approaches is not one of domain but rather of attention to structure versus surrounding context. Where the existing approaches pay attention to whether a given phrase is or isn't a TP/EDU, regardless of where it appears, the generalization proposed here is sensitive to the environment in which the phrase occurs, in particular the embedding operators. If one does not attribute pdref introduction to the embedding context, then one is forced to explain the non-uniform behavior of phrases like *them married* or *Lucy to be at the party*. On the current approach, two phrases which are string-identical can differ in semantic type if one is type-shifted (e.g., from an event to a proposition), and such an operation might be required for that phrase to be taken as an argument of an operator which only takes propositional arguments (e.g., the verbs *believe* and *doubt*). In contrast, a purely syntactic or discursive approach would have to explain this non-uniform behavior without making reference to this sort of motivated type-shifting.

4.3. Comparison with Karttunen (1969)

Like the generalization proposed here, that of Karttunen (1969) is sensitive to context in the way described above; that is to say, it looks beyond the structure itself. That said, the context sensitivity of the two proposals differs in two ways.

According to Karttunen (1969), what introduces (individual) discourse referents isn't just the structure NP, but rather the NP in particular contexts, namely sentences whose propositional content is "asserted, implied or presupposed by the speaker to be true". This stipulation is the first important point of departure between these two generalizations: the introduction of propositional discourse referents is crucially insensitive to truth. As we saw in (2), the prejacent of sentential negation has an associated pdref, where that prejacent proposition is not only not "asserted, implied or presupposed by the speaker to be true", but is in fact asserted by the speaker *not* to be true. The introduction of individual drefs, then, is sensitive to truth in a way that the introduction of propositional drefs is not.

The context sensitivity of these generalizations also differs in terms of locality: the generalization proposed here is sensitive only to the immediate context of the phrase in question—its embedder—where Karttunen's (1969) generalization is sensitive to the global context of a noun phrase—the truth status of the sentence[5]—regardless of the local context in which the noun phrase appears.

The generalizations proposed here and in Karttunen (1969) are also similar in that they both adhere to versions of what has been called in the nominal domain the *formal link* condition/constraint: the requirement that an e-type pronoun have an overt NP antecedent, and that that antecedent not be a sub-part of a word (see Postal, 1969; Evans, 1977; Kadmon, 1987; Heim, 1990; Patel-Grosz and Grosz, 2010 among others).[6] This need for a formal link has been invoked to explain contrasts like (31) and (32).

(31) a. One of the ten balls is missing from the bag. It's under the couch.
b. # Nine of the ten balls are in the bag. It's under the couch. (Partee, 1989)

(32) a. Linus owns a dog and it bites him.
b. # Linus is a dog-owner and it bites him. (cf. Evans, 1977)

Even though the question of the location of the tenth ball is equally salient in both versions of (31), only when that ball itself is overtly mentioned is anaphoric reference to it felicitous. That *nine of the ten balls* entails the existence of a tenth ball is not enough for that tenth ball to be referred to anaphorically. Similarly, even though what it means to be a dog-owner is to own a dog, and even though the word *dog-owner* contains the string *dog*, nevertheless the anaphor *it* cannot refer to the dog that Linus owns in (32b). And, if one objects to (32) on the basis of uniqueness—that *dog-owner* is underspecified about the number of dogs which are owned, thus not satisfying the uniqueness requirement of *it*—the same objection probably can't be levied against (33), on the assumption that people have at most one nose.[7]

(33) a. Marcie had a bloody nose, and now it's sore.
b. # Marcie had a nosebleed, and now it's sore.

The discussion of this phenomenon in the literature has been restricted to the nominal domain, but a parallel constraint appears to be present in the propositional domain as well. While the generalization advanced here does not associate pdref introduction with any particular structure, it does require that the propositions being referred to be represented overtly—albeit in the semantic representation, not the syntactic one—in the same way that the formal link condition requires overt antecedents. This has already been illustrated here, insofar as a proposition's being entailed by a sentence is not enough for that proposition to be available for anaphoric reference, as we saw for example with the causative small clause in (8). The same is true of the existence presupposition associated with a *wh-* question, as in (34).

(34) Who was at the party? Because Lucy told me *that*.
intended: that someone was at the party EXISTENCE PRESUPPOSITION

[5]That is, the truth status from the perspective of the speaker.

[6]That Karttunen (1969) identifies individual dref introduction with (a subset of) overt NPs ensures that the first clause of the formal link condition is satisfied. And if one considers the incorporation of *dog* in the word *dog-owner* (as in (32b)) to be morphological, rather than syntactic, then Karttunen's generalization satisfies the second clause as well.

[7]My thanks to Eitan Grossman for help in constructing this pair of examples.

And as perhaps the closest parallel to Partee's (31), we can also observe that only the nucleus proposition which partitions a polar question, and not its complement, has an associated propositional discourse referent, as illustrated in (35) & (36).[8]

(35) Did Franklin go to the party? Because Lucy told me *that*, but I didn't see him there.
✓*intended*: that Franklin went to the party NUCLEUS

(36) Did Franklin go to the party? Because Lucy told me *that*, but I thought I saw him there.
#*intended*: that Franklin didn't go to the party COMPLEMENT

This suggests that while there are differences between the introduction of individual and propositional discourse referents, they also share deep similarities.[9]

5. Implementation

The previous section introduced a novel generalization about the introduction of propositional discourse referents: operators which take propositional arguments introduce discourse referents for those arguments. In this section, I sketch out one way that this generalization could be modeled formally, using Update with Modal Centering (UC_ω, Bittner, 2011).

Update with Modal Centering is an update semantics which tracks knowledge via a changing information state. The information state is a set of pairs of lists of discourse referents; each pair consists of a top ($\top$) list and a bottom ($\bot$) list, which respectively model the center and periphery of attention. What makes UC_ω an attractive option for modeling the generalization discussed in the previous section is that it tracks discourse referents not only for individuals (type δ), but also for events (ε), states (σ), times (τ), worlds (ω), and propositions (ωt).[10] As such, it already includes the formal tools we need in order to model the introduction of propositional discourse referents; what remains is to describe precisely how that is handled in this system. In order to do so, it will be instructive to look at a toy example of what UC_ω looks like.

Abstracting over tense for present purposes, a simple predication like *Marcie danced* will be given the UC_ω translation as in (37).

(37) Marcie danced $\rightsquigarrow {}^{\top}[\, x \mid x = \text{marcie}\,];\ [\, w \mid \text{danced}_w\langle \top\delta\rangle\,]$

Each expression enclosed in square brackets represents one update, and sequential updates are delineated by a semicolon. The first update in (37) adds an individual discourse referent to the $\top$-list, identifying that discourse referent with the individual marcie (given by the model). The second update adds a world-type discourse referent to the $\bot$-list, a variable over those worlds in which it is true that the topical individual ($\top\delta$)—the individual most recently added to the $\top$-list, so here marcie—danced in those worlds.[11] In this way, UC_ω models each morpheme as

[8]This has consequences for how we interpret the semantics of a polar question, suggesting a formal representation only of the nucleus proposition (along the lines of Bolinger, 1978), in contrast to a Hamblin semantics where both propositions are represented equivalently, though the latter may still be accurate for *wh*- questions and alternative questions (see Gawron, 2001; Rooij and Šafářová, 2003, among others).

[9]See Snider (2017a) for more on the formal link condition on propositional anaphora.

[10]I omit here the full formal definitions which underlie UC_ω; see Bittner (2011).

[11]This update is the sort which can expand the number of pairs of lists in the information state. If there are multiple

contributing one or more discrete updates, where each update crucially depends on one another in order to model the desired compositional meaning: the verb *danced* introduces the worlds in which the topical individual danced, and it is only when it follows the update triggered by the name *Marcie* that that topical individual is guaranteed to be marcie.

The translation in (37) does not fully reflect the effects of an assertion of the sentence *Marcie danced*, however. We have introduced a set of worlds, but haven't done anything with those worlds, updated the common ground, learned about the actual world, etc. In order to handle that, we supplement (37) with the declarative mood marker DECL, which in English has a phonological reflex at least in terms of intonation. Building on Murray (2014), we associate DECL with four distinct updates.

(38) $\text{DECL} \rightsquigarrow [\, p \,|\, p = \bot\omega\| \,];\ [\, \bot\omega \in \top\omega\| \,];\ [\, \top\omega = \bot\omega \,];\ {}^{\top}[\, p \,|\, p = \top\omega\| \,]$

The first update introduces a propositional discourse referent into the $\bot$-list[12] for the bottom world column ($\bot\omega\|$), the set consisting of the collection of the most prominent worlds across all of the $\bot$-lists in the information state. (Recall that the information state is a set of pairs of lists; $\|$ operates across each pair in the set.) This set of worlds will be the set of worlds just introduced in the previous update, those worlds in which the matrix predication holds, i.e., here, the worlds in which Marcie danced. The same way that *danced* relies on the prior update to ensure that its argument introduces the topical individual, DECL relies on the fact that its argument—the matrix clause—will have introduced a set of worlds to be collected and labeled with a propositional discourse referent. It is this update which does the work we most care about here: it introduces the propositional discourse referent associated with the matrix clause.

The second, third, and fourth updates of (38) are as presented in Murray (2014). The second update represents a proposal to update the common ground, by restricting the (most prominent) $\bot$-worlds—the worlds associated with the matrix clause—to a subset thereof, down to only those which are also in the set of topical worlds ($\top\omega\|$), i.e., the context set. The third update-models the actual update of the context set by restricting the (most prominent) $\top$-worlds—the worlds in the context set—to only those worlds which match their respective (most prominent) $\bot$-world—a member of the subset of the worlds associated with the matrix clause, created by the previous update. And finally, the fourth update introduces a new propositional discourse referent into the $\top$-list for this newly-restricted context set, to act as the starting point for updates triggered by subsequent utterances.

Murray (2014) associates the second, third, and fourth updates of (38) with the declarative mood. The first update—the one we are most interested in here—is part of the presentation of

worlds in which the condition is met—here, where the topical individual danced—then the output information state is one in which there is a pair of $\top/\bot$-lists for each such world. The $\top$-list in each pair will contain (the discourse referent associated with) marcie, and each $\bot$-list will contain (a discourse referent associated with) a different world in which Marcie danced.

[12] UC adds propositional discourse referents to the $\top$-list only to represent the context set; this is a privileged position, ensuring that sentence- and discourse-initial updates always interact with the information state in the desired way. As a result, all of the propositional discourse referents used for anaphora—those we are interested in here—will be added to the $\bot$-list. Other types of discourse referents are added to either $\top$ or $\bot$ on the basis of their center/periphery status.

an utterance's at-issue content in Murray (2014), not directly linked to any specific morpheme. Here, we associate this update with DECL, but also crucially with other proposition-taking operators. As part of DECL, $[\, p \,|\, p = \bot\omega\| \,]$ introduces a propositional discourse referent for the matrix clause, but only as a result of following the updates associated with the matrix clause. The same update can do parallel work for non-matrix content when it is associated with other operators, as the information state of the system is different. For example, if we associate this same update with sentential negation, we get a UC$_\omega$ translation as in (39).

(39) NEG $\rightsquigarrow [\, p \,|\, p = \bot\omega\| \,];\ [\, w \,|\, w \notin \bot\omega\| \,]$

On this analysis, the NEG operator associated with sentential negation triggers two updates. The first introduces a propositional discourse referent for the set of most prominent $\bot$-worlds across the entire information state; this will be the set of worlds associated with the prejacent of sentential negation. The second introduces into the $\bot$-list the worlds *not* currently in the set of those most prominent $\bot$-worlds, i.e., those not in p; these worlds collectively make up the complement set of the prejacent worlds.[13]

To see this in action, consider a sentence like *Marcie didn't dance*. This will get an analysis equivalent to DECL (NEG (*Marcie danced*)).[14] NEG introduces the pdref for the worlds in which Marcie danced (the prejacent of sentential negation), and DECL introduces a pdref for the worlds in which she didn't (the matrix clause). In both cases it is the same update—$[\, p \,|\, p = \bot\omega\| \,]$—which is responsible for pdref introduction. It is the context in which the update occurs, in particular which worlds are the current most prominent $\bot$-worlds, which determines which set of worlds get associated with a new propositional discourse referent.

This pattern extends to other proposition-taking operators: by associating them with the same UC$_\omega$ update, they too introduce discourse referents for their arguments.

(40) say $\rightsquigarrow [\, p \,|\, p = \bot\omega\| \,];\ [\, w \,|\, \mathrm{say}_w\langle \top\delta, \bot p\rangle \,]$

For a proposition-embedding verb like *say*, for instance, the UC$_\omega$ translation in (40) makes use of this same update. The first update of (40) introduces a pdref for the currently most prominent $\bot$-worlds, which will be those worlds associated with *say*'s complement clause. The second update then introduces into the $\bot$-lists those worlds where the topical individual ($\top\delta$) is in a saying relation with the most prominent $\bot$ proposition, which will be the very proposition introduced by the previous update. The treatment will be parallel for other proposition-taking operators, including embedding verbs like *believe* and *expect* (but not verbs like *want* and *ask*): their UC$_\omega$ translation will include the same update as DECL and NEG, which is responsible for the introduction of pdrefs, along with the other update(s) associated with their lexical meaning.

[13] One can also think about this second update as equivalent to $[\, w \,|\, w \notin \bot p]$, where rather than referring again to the same set of worlds via $\|$, the second update instead refers to the pdref introduced by the first update. Considering that propositions are sets of worlds, these are equivalent. This second formulation is reminiscent of Stone and Hardt (1999), wherein both modals and sentential negation are anaphoric on propositions, as the second update would crucially rely on the discourse referent introduced in the first.

[14] As noted above, I abstract here over tense. The actual UC$_\omega$ translation of *Marcie didn't dance* will also be more complicated than sketched here in that the morpheme associated with sentential negation, *n't*, is located between the words which comprise its prejacent. See Bittner (2011) for details on compositional rules for UC$_\omega$ in the style of Combinatory Categorial Grammar (CCG, Steedman, 2000) which allow for non-string-contiguous morphemes to compose.

6. Summary

While researchers have investigated under what circumstances individual discourse referents are introduced, less work has been done on addressing the same question for the propositional domain. This project attempts to close that gap. In this paper, I have reviewed two types of approaches to the question of pdref introduction which are represented in the literature: a syntactic approach which associates pdref introduction with syntactic categories such as TP, and a discursive approach which assigns pdrefs to (sub)DRSs or EDUs. I then presented data which challenge both of these approaches, including data from small clause constructions, nominal adverbial constructions, and a variety of raising and control constructions. This data led me to propose a novel generalization, one sensitive to semantic type: proposition-embedding operators—including the declarative mood, sentential negation, and a number of embedding verbs, among others—introduce discourse referents for their propositional arguments.

With this new generalization in hand, we were able to make comparisons not only to the existing approaches to propositional dref introduction mentioned above, but also to Karttunen's (1969) generalization for individual dref introduction. The two generalizations differ in their sensitivity to truth: individual drefs are only introduced in contexts where the speaker takes the sentence to be true, where even propositions asserted to be false can have associated pdrefs. On the other hand, the propositional generalization proposed here and the individual generalization from Karttunen (1969) are similar in that both adhere to their respective versions of the formal link condition.

Finally, I described one way that the proposed generalization can be modeled formally, using Update with Modal Centering. Building on insights from Bittner (2011) and Murray (2014), I identified a particular update which is responsible for introducing propositional discourse referents in simple unembedded clauses. I then showed how it can be associated not only with the declarative mood (and thus matrix clause content), but also with sentential negation and other proposition-embedding operators. The result is a system which tracks propositional discourse referents, including for sentences with multiple such pdrefs which might be suitable antecedents for subsequent anaphoric reference. This implementation is straightforward in that the same update serves the same function, being associated with different propositional operators. That said, this is just one possible implementation; the same generalization can be modeled in other systems as well.

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Toward a unified analysis of internal and external comparison

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Abstract. English comparatives in predicative position can be used to compare one individual to itself at a different point in time or space, e.g. in *The river is wider*. I identify grammatical distinctions between these internal comparatives and the more standardly analyzed class of external comparatives. On the basis of these grammatical differences, I argue that expressions of internal comparison are of a different semantic type than those of external comparison, viz. that a sentence containing an internal comparative is a relation between intervals in the domain of the denotation of the subject, conceived of as an individual concept. On this account, internal comparatives are semantically similar to degree-achievement verbs like *widen* in that they express a change in the degree of some property of the subject across an axis of measurement. The grammatical differences between internal and external comparatives then fall out from the semantics of internal comparison.

Keywords: comparatives, individual concepts, degree constructions, value change.

1. Introduction

Comparatives in predicative position in English can be used in two apparently different senses. The first, and more common, use of a predicative comparative is to express what I'll refer to as *external* comparison: the sentence containing the inflected adjective compares one individual to another.[1]

(1) The river is wider than the footpath. **External comparative**

In these cases, an individual's degree of some property is compared to another individual's degree of the same property: here, the river and the footpath are compared according to their degree of width. The second use of a comparative, and the focus of this paper, is to compare stages or parts of the same individual—that is, to express *internal comparison*:

(2) The river is wider. **Internal comparative**

(2) is most naturally read as predicating of the river that its degree of width now is greater than its degree of width at some (contextually salient) prior point in time.[2] Sheldon (1945) refers to this as an 'incomplete' comparative because it lacks an overt *than*-argument. An internal comparative expresses a meaning very similar to that of a sentence involving a degree-achievement verb like *widen*:

(3) The river widened.

[1]Throughout this paper, for the sake of simplicity, I focus on phrasal comparatives, i.e. those whose comparand *than*-arguments are individuals (syntactic DPs).
[2]The external reading is of course still available here, though dispreferred.

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The present analysis takes seriously the intuition that internal comparison and degree-achievement verbs are closely related phenomena. More concretely, I argue that sentences containing internal comparatives denote relations between intervals along an axis, following work by Deo et al. (2013). Splitting internal from external comparison in this way accounts for some puzzling differences between the two constructions that have escaped notice in the literature. Most crucially, internal comparison, but not external comparison, licenses the use of certain axis-sensitive adverbial modifiers. In this paper, I'll focus on two: *as*-phrases, such as *as you go north*, and *with*-phrases, such as *with increased smoking*. The relevant pairs follow:

(4) a. ✓ The river is wider as you go north. **Internal**
b. # The river is wider **than the footpath** as you go north. **External**

(5) a. ✓ The risk of cancer is greater with increased smoking. **Internal**
b. # The risk of cancer is greater **than the risk of emphysema** with increased smoking. **External**

The second sentences in these examples are, if not syntactically malformed, certainly semantically anomalous. (The sense that they are syntactically well-formed is the reason for marking them with a '#' rather than a '*'.) What's wrong with them? As a first pass, the problem with (4b) seems to be that *as you go north* wants to modify something that expresses a change in value. While *being wider than the footpath* doesn't fit the bill, simply *being wider* apparently does. The same goes for the sentences in (5); *with increased smoking* seems to want an expression of value change.

To illustrate this contrast better, we may note the same distinction between the applicability of *be wide* and *widen*. Stative *be wide* is like an external comparative in resisting appearing with axis-oriented modifiers; change-of-state *widen*, however, is fine with them:

(6) a. # The river is wide as you go north.
b. ✓ The river widens as you go north.

Internal comparison, I argue, expresses a value difference across stages or parts of a structured individual, making an internal comparative a kind of *difference description* in the sense of Deo et al. (2013). Internal *wider* in (4a) is of a different semantic type than external *wider* in (4b), more similar to *widen* than to *be wide*. For type-theoretic reasons, *as you go north* is unable to compose with the phrase containing external *wider*.

The present approach is couched in the Deo et al. (2013) analysis of degree-achievement verbs. On that analysis, DPs denote so-called *generalized individual concepts*, functions from intervals of some ordering dimension to individuals. In the spatial and temporal cases, an individual in the codomain of a generalized individual concept is conceived of as a spatial or temporal 'slice' of that individual, corresponding to the time or location that the individual concept is fed as an argument.

The present proposal, then, is straightforward, positing a systematic ambiguity in the denotation of phrasal comparative adjectives. Internal comparative adjectives accept exactly one individual-concept argument; comparison is then done between two entities that correspond to different spatial or temporal slices of the individual denoted by that individual concept. Crucially, the resulting denotation is a relation between intervals. Internal *wider*, for instance, has the following denotation, where χ is a placeholder type:

(7) $[\![\text{wider}_{int}]\!] : \chi e \to (\chi \to \chi t) \equiv$
$\lambda f_{\chi e} i_\chi j_\chi.\mathbf{max}(\lambda d.\mathbf{wide}(d)(f(j))) > \mathbf{max}(\lambda d.\mathbf{wide}(d)(f(i)))$

This is a function that wants an individual-concept argument f of type $\chi \to e$ and two intervals i and j of type χ; it returns True just in case $f(j)$ is wider than $f(i)$.

External *wider*, in contrast, wants two individual-concept arguments f and g, corresponding to two individuals. It then evaluates the width of those individuals at the same point of evaluation i:

(8) $[\![\text{wider}_{\text{ext}}]\!] = \lambda f_{\chi e} g_{\chi e} i_\chi.\mathbf{max}(\lambda d.\text{wide}(d)(g(i)) \; > \; \mathbf{max}(\lambda d.\text{wide}(d)(f(i))$

The upshot is that the external and internal senses of the comparative morpheme result in expressions of different types. Axis-sensitive adverbials like *as you go north* can only licitly compose with relations between intervals:

(9) $[\![\text{As you go north}]\!] : (\sigma \to \sigma t) \to t \equiv$
$\lambda R_{\sigma \to \sigma t} \forall l, l' \subseteq L_{s \to n}.l < l' \to R(l')(l)$

2. Characterizing the phenomenon

Readings of internal comparison are generally only available in predicative position. Comparatives modifying a subject (10a) or object don't give rise to internal-comparative readings:

(10) Context: *At the beginning of the school year, Alice was taller than Barbara; now, they're the same height.*
  a. # The taller girl took French. (with the meaning *Barbara took French.*)
  b. # The teacher saw a taller girl at recess. (with the meaning *The teacher saw Barbara at recess.*)

Internal comparison is done along an axis in the sense of Gawron (2005): a set of points with a well-ordering. In many cases, perhaps the majority, this axis is time. But an axis can also be spatial, informational, or functional (terms borrowed from Deo et al. 2013):

(11) a. The river is wider here. **Spatial axis**

b. The plot is better after chapter three. **Informational axis**
c. The risk of cancer is higher with increased smoking. **Functional axis**

Why (11a) and (11b) are instances of spatial and informational axes, respectively, is obvious; (11a) asserts that the river is wider here than at some prior point in space, and (11b) asserts that the plot is better after chapter three than at some prior informational point. (11c) is the most interesting example of this set. Deo et al. (2013) refer to this type of reading (for degree-achievement predicates) as ‘functional’, because it asserts a functional relationship between frequency or severity of smoking and the risk of cancer; here, the axis is individuals ordered by how much they smoke.

Internal readings interact with temporal adjuncts in interesting ways. When a temporal adjunct is universally quantified over, the sentence has a special interpretation:

(12) The river is wider every year.

The meaning of (12) seems to be that for each pair of years x and y (where x immediately precedes y), the river is wider at y than at x. Note that this sentence does *not* mean that every year, the river is wider than it was at some contextually salient prior time; rather, it entails that each year the river widens. Zwarts et al. (2004) refer to this as a ‘consecutive‘ interpretation. This stands in stark contrast to the analogous externally comparative sentence:

(13) The river is wider than the footpath every year.

The meaning of (13) is merely that each year, the width of the river exceeds that of the footpath.

Zwarts et al. (2004) consider a construction that is similar to, but crucially distinct from, internal comparison as defined in this paper, which they term *reflexive comparatives*, e.g. the following:

(14) Every match doesn’t get easier.

Crucially, their examples contain the change-of-state verb *get*, which I assume is synonymous (for adjectival complements) with *become*. But much of the data is similar to that for internal comparatives, including the so-called ‘consecutive’ interpretation for universal quantifiers.

2.1. The missing *than*-argument

Internal comparatives typically occur without an overt comparand (the *than*-argument of a comparative). In many cases they can be paraphrased with one:

(15) The river is wider here **than back there**.

We might think that internal comparatives *always* have such an argument, but when it doesn't appear overtly, it's pragmatically retrieved or somehow otherwise implicit. But crucially, sometimes expressions of internal comparison may not be paraphrased with any overt *than*-argument. (11c) is an illustrative example. As we noted before, what (11c) expresses is something like *The more you smoke, the higher your risk of cancer is*. It's clear that this meaning isn't preserved with any choice of an overt *than*-argument to the comparative:

(16) a. ?? The risk of cancer is higher with increased smoking **than with decreased smoking**.
b. ?? The risk of cancer is higher **than before** with increased smoking.
c. ?? The risk of cancer is higher with increased smoking **than otherwise.**

None of the sentences in (16) captures the meaning of (11c). The fundamental issue is that inserting an overt *than*-argument seems to force a reading wherein there is some particular degree of cancer risk d, and that degree of risk is being compared to some other particular degree d'. But the interpretation of (11c) plainly doesn't make reference to any *particular* degrees of risk d and d'. Rather, it says that the $>$ relation holds between *any* two degrees d and d' if the individual who has risk d smokes more than the individual with risk d'.

The problem of unparaphrasability with an overt *than*-argument isn't restricted to functional readings; it also appears in internal comparison constructions with *as*-modifiers:

(17) The river is wider (??than before) as you go north.

Again, (17) doesn't make reference to any particular spatial parts of the river; it says, roughly, that for any two spatial intervals of the river, the *wider* relation holds between them if the first one is more north than the second. This is strikingly similar to the meanings of sentences with degree-achievement verbs like *increase* and *widen*. Indeed, these degree-achievement verbs can occur in the same sentences with no obvious difference in meaning:

(18) a. The risk of cancer **increases** with increased smoking.
b. The river **widens** as you go north.

2.2. Internal and external comparatives allow different modifiers

The data in the previous section showed that in sentences with internal comparatives modified with *with*- and *as*-phrases, it's difficult to find an overt comparand argument that preserves the meaning of the original sentence. This section shows that internal comparatives are unique among comparative constructions in allowing these modifiers in the first place.

As you go north, according to Deo et al. (2013), quantifies over (pairs of) subintervals of an axis: in this case, the river ordered south-to-north. If *The river is wider* denotes a relation between subintervals of the river, then it's fairly clear how this proceeds compositionally: *as you go north* imposes the requirement that this relation holds between any two subintervals where the first is more northerly than the second. Crucially, this line of reasoning requires that *The river is wider* denotes a relation between intervals of the river.

What happens in a sentence with external comparison? In this case, the width of the river is being compared to that of some other object:

(19) The river is wider than the footpath.

Here, the relation that's expressed by the comparative is one between individuals, not intervals. We would then expect that an axis-sensitive modifier like *as you go north* would be illicit: it wants a relation between intervals, not individuals, as an argument. As we have seen, this prediction is borne out:

(20) # The river is wider than the footpath as you go north.

Deceptively, (20) almost appears acceptable on first glance: it's not obviously syntactically ill-formed. But what kind of situation might it describe? At any given point, the river is either wider than the footpath, or else it isn't; it isn't clear how this relation could hold as one goes north. Other axis-sensitive modifiers, like *with*-phrases, exhibit the same contrast.

(21) # The risk of cancer is greater than the risk of emphysema with increased smoking.

Here, again, (21) may seem grammatical at first blush. But the sentence is semantically anomalous; *with increased smoking* wants an arugment expressing a change in value, which *The risk of cancer being greater than the risk of emphysema* does not.

3. Analysis

Following Deo et al. (2013), I assume that DPs denote functions from intervals of a contextually-retrieved axis to individuals; Deo et al. refer to these as *generalized individual concepts*. In this framework we can express the meaning of *the river* as follows:

(22) $[\![\text{the river}]\!] : \chi \to e \equiv \lambda i_\chi.\mathbf{the.river}(i)$

Here, and in the following discussion, I use χ as a placeholder type for intervals of any arbitrary axis, because *the river* (and in fact any DP) will be polysemous with respect to its axis. For example, χ may be instantiated as σ, the type of spatial intervals, or τ, the type of temporal intervals. The type of this axis is generally pragmatically retrieved, although certain modifiers may force a particular interpretation. (For instance, *As you go north* will force a spatial interpretation of the DP.)

I assume an analysis of gradable adjectives on which they denote functions of type $d \to et$, i.e. relations between degrees and entities, as is a standard assumption in the literature on gradable adjectives, comparatives, and superlatives (see e.g. Heim 1999). For us, this decision doesn't amount to much; a theory on which gradable adjectives denote measure functions (as in e.g. Kennedy 1997) would work just as well. Thus the denotation of bare *wide* is as follows, a function that takes a degree d and individual x, returning True iff x is at least d-wide:

(23) $[\![\text{wide}]\!] : d \to et \equiv \lambda d_d.\lambda x_e.wide(d)(x)$

As an aside, this denotation for gradable adjectives immediately raises the question of how a bare adjective can compose with an individual-concept subject, as in *The river is wide*. Let's assume for simplicity that a **pos** morpheme somehow saturates the degree argument of the bare adjective (how exactly it does so isn't important for our purposes). Then we have an expression **pos** *wide*, which is a property of entities that exceed the contextual determined norm for counting as *wide*:

(24) $[\![\textbf{pos}\ \text{wide}]\!]\ e \to t \equiv \lambda x_e.wide(\text{norm}_{wide})(x)$

This expression is type $e \to t$, which can't directly compose with something of type $\chi \to e$. There are at least two plausible options: one is to feed the type-χ argument to the individual concept function before composing with the adjective. The other is to invoke a Geach-rule (Geach, 1970) typeshifting rule, which turns $[\![\textbf{pos}\ \text{wide}]\!]$ into a $\chi e \to \chi t$-expression:

(25) **Geach typeshifting**: Any expression of type $e \to t$ can be shifted to an expression of type $\chi e \to \chi t$ by the application of the typeshifting function **g**:
$\mathbf{g} = \lambda P_{et} f_{\chi e} i_{\chi}.P(f(i))$

Although it's not directly relevant for us, I assume the typeshifting rule can freely apply, which means that (untensed) sentences are type $\chi \to t$, i.e. properties of intervals, as Deo et al. (2013) assume:

(26) $[\![\text{The river is } \textbf{pos}\ \text{wide}]\!] : \chi \to t \equiv \lambda i_{\chi}.wide(norm_{wide})(\textbf{the.river}(i))$

So *The river is wide* is a property of intervals such that the river is wide to at least the degree $norm_{wide}$. The interval argument may be supplied overtly (e.g. by tense, if χ is resolved as τ, the type of temporal intervals), or covertly, by supplying the sentence with the current interval of evaluation. With this as background, we can move on to the positive proposal for internal comparison.

3.1. Two types of comparatives

Typically in the literature, the comparative morpheme *-er* is taken to express a relation between sets of degrees (Cresswell, 1976; von Stechow, 1984), or in the phrasal case (where the comparand argument is a DP), entities. These sets of degrees are the denotations of clauses that abstract over a d-type argument by means of a *wh*-operator Op_d; for an overview, see Schwarzschild (2008) or Rett (2014). This results in a denotation for *-er* like the following:

(27) $[\![\text{-er}]\!] : dt \to dt \to t \equiv \lambda D'_{dt} D_{dt}.\mathbf{max}(D) > \mathbf{max}(D')$

The underlying structure of a comparative, then, is schematically as follows (adapted from Rett's (34)):

(28) a. The river is wider than the footpath.
b. *-er*([$Op_{d'}$ the footpath is d'-wide])([Op_d The river is d-wide])

But if comparatives always denote relations between sets of degrees, then accounting for the grammatical differences between internal and external comparison is difficult. The properties of internal comparison we noted before are wholly unexpected if internal comparison involves the same semantic machinery as external comparison. If the denotation of *-er* always wants the denotation of a *than*-clause as an argument, why should it be impossible to insert one overtly in some instances of internal comparison?

Given this puzzle, I argue that internal-comparison *-er* doesn't accept a *than*-argument at all; when there *is* an overt *than*-argument, *-er* is never interpreted as genuinely internal comparison. Interestingly, an analysis (of phrasal comparatives) that treats comparatives as denoting relations between individuals can shed some light on the relationship between internal and external comparison. Let's entertain a denotation for *-er* as follows:

(29) $[\![\text{-er}]\!] : (d \to et) \to (e \to et) \equiv \lambda G_{d \to et} x_e y_e.\mathbf{max}(G(y)) > \mathbf{max}(G(x))$

This meaning for *-er* turns out to give us a good basis to develop an analysis of internal and external comparison. As in the case of bare gradable adjectives like **pos** *wide*, here there's a type mismatch between an individual-concept subject (type χe) and the relation denoted by the comparative adjective. But there are multiple ways to typeshift a relation between e-type objects into something that takes some number of individual-concept arguments. The solution I adopt here, for ease of explication, is simply to posit an ambiguity in the denotation of *-er*. Both denotations have a shape like that of (29), but they differ with respect to the number of individual-concept arguments they accept. (Another solution would be to have (29) as a single lexical entry for *-er*, and then derive the internal and external variants by means of two typeshifters similar to (25).)

On the ambiguity approach, external *-er* accepts a gradable predicate and two individual-concept arguments, returning a function from intervals to truth values (i.e. a property of intervals):

(30) $[\![\text{-er}_{\text{ext}}]\!] \equiv \lambda G_{d\to et} f_{\chi e} g_{\chi,e} i_\chi.\mathbf{max}(\lambda d.\mathrm{G}(d)(g(i))\ >\ \mathbf{max}(\lambda d.\mathrm{G}(d)(f(i))$

The river is wider than the footpath will then be a function from an interval of some contextually retrieved axis to True just in case, at that interval, the width of the river exceeds the width of the footpath. This interval might be e.g. the present moment in time, if the individual-concept arguments are interpreted as type τe, functions from temporal intervals to entities; or the current location, if the individual-concept arguments are interpreted spatially.

Internal *-er*, on the other hand, turns a gradable predicate into a relation between subintervals of the domain of a single individual-concept subject:

(31) $[\![\text{-er}_{\text{int}}]\!] \equiv \lambda G_{d\to et} f_{\chi e} i_\chi j_\chi.\mathbf{max}(\lambda d.\mathrm{G}(d)(f(j))\ >\ \mathbf{max}(\lambda d.\mathrm{G}(d)(f(i))$

We can think of external *-er* as picking two individuals and comparing them at one point (or, more precisely, one interval) of evaluation. Internal *-er*, in contrast, picks a single individual and varies the point of evaluation. These correspond to two strategies for getting two individuals to compare: by choosing different individual-concept functions and feeding them the same input (external comparison), or by choosing one individual-concept function and feeding it two inputs (internal comparison). The denotation for an internal-comparison sentence is then as follows:

(32) $[\![\text{The river is wider}_{int}]\!]\ :\ \chi \to \chi t\ \equiv$
$\lambda i_\chi j_\chi.\mathbf{max}(\lambda d.\mathbf{wide}(\mathbf{the.river}(j))) > \mathbf{max}(\lambda d.\mathbf{wide}(\mathbf{the.river}(i)))$

(32) is a relation between two subintervals in the domain of the river; it comes out true just in case the entity that $[\![\text{the river}]\!]$ maps to at the second interval is wider than what it maps to at the first.

There are at least two options for saturating the first interval argument. The first is that it's pragmatically supplied, as in a bare sentence like *The river is wider*; intuitively, the comparand in this sentence is some already salient point in time or space. A second option is for this relation to serve as the argument of an axis-sensitive modifier:

(33) $[\![\text{As you go north}]\!]\ :\ (\sigma \to \sigma t) \to t\ \equiv$
$\lambda R_{\sigma\to\sigma t} \forall l, l' \subseteq L_{s\to n}.l < l' \to R(l')(l)$

This denotation is minimally modified from Deo et al.'s (53). *As you go north* fixes an axis $L_{s\to n}$, a set of spatial points ordered from south to north, and wants a relation between spatial intervals as an argument. It returns True just in case, for every pair of subintervals in $L_{s\to n}$ where the first is more north than the second, that relation holds. Thus we have:

(34) $[\![\text{As you go north}]\!]([\![\text{the river is wider}_{int}]\!]) : t \equiv$
$\forall l, l' \subseteq L_{s \to n}. l < l' \to \mathbf{max}(\lambda d.\mathbf{wide}(\mathbf{the.river}(l))) > \mathbf{max}(\lambda d.\mathbf{wide}(\mathbf{the.river}(l')))$

This expression is true just in case, for all pairs of subintervals of the given south-north axis $L_{s \to n}$, the more northern one is wider than the more southern one. *With*-modifiers work similarly (adapted from Deo et al.'s (34)):

(35) $[\![\text{With increased smoking}]\!] : \chi \to t \equiv \lambda R_{\chi \to \chi t}.\forall x, y \subseteq C_{<smoking}.x < y \to R(y)(x)$

Like the *as*-modifier, *with increased smoking* fixes an axis: this time $C_{<smoking}$, a set of elements type χ ordered by their intensity of smoking. It then takes the relation denoted by the clause it modifies as an argument:

(36) $[\![\text{With increased smoking}]\!]([\![\text{The risk of cancer is higher}]\!]) : t \equiv$
$\forall x, y \in C_{<smoking}.x < y \to \mathbf{max}(\lambda d.\mathbf{high}(d)(\mathbf{risk.of.cancer}(y))) >$
$\mathbf{max}(\lambda d.\mathbf{high}(d)(\mathbf{risk.of.cancer}(x)))$

Here, the individual-concept function $[\![\text{the risk of cancer}]\!]$ is a function from entities to their risk of cancer, i.e. of type $e \to e$. (36) is true just in case, when you order the relevant set of individuals C by its severity of smoking, for every pair of entities $\langle x, y \rangle$ such that x outranks y, x's risk of cancer is higher than y's.

3.2. The connection to degree achievements

The analysis of degree achievements presented by Deo et al. (2013) is in part phrased as a response to Kennedy and Levin (2008). Kennedy and Levin proposed analyzing degree-achievement verbs in terms of degree change over the course of an event. On their view, *The river widened* denotes a property of events in which the river's width is greater at the end than at the beginning.

Deo et al. (2013) argue, in essence, for moving the time argument (which for Kennedy and Levin is more precisely an event argument) into the meaning of the subject of the degree-achievement verb, turning the subject into an individual concept. This allows for an elegant account of e.g. spatial or functional readings of *widen*, which don't plausibly involve change over the course of an event *per se*. Thus the Deo et al. denotation for *The river widen* is as follows, where i_{init} and i_{end} refer to the minimal beginning and ending subintervals of i:

(37) $[\![\text{The river widen}]\!] : \chi \to t \equiv$
$\lambda i_{\chi}.\mathbf{max}(\lambda d.\mathbf{wide}(d)(\mathbf{the.river}(i_{init}))) > \mathbf{max}(\lambda d.\mathbf{wide}(d)(\mathbf{the.river}(i_{end})))$

(Here, the verb is left untensed (*widen* instead of *widens*) to indicate that this is the meaning of an untensed sentence.) The denotation in (37) is crucially different from our denotation for internal comparatives in that it accepts only one type-χ argument; i.e., it denotes a property of intervals in the domain of $[\![$the river$]\!]$, not a relation between them. One crucial way in which they appear to differ is their interpretation with durative *for*-adverbials:

(38) a. The river widened for five miles.
b. The river was wider for five miles.

(38a) expresses that the river continuously increases in width along a particular five-mile subinterval. (38b), on my judgment, lacks this reading; instead, it seems to mean that there's a five-mile subinterval of the river that is wider than some contextually salient other interval. This may be a reason not to totally assimilate degree-achievement verbs and internal comparatives. However, in the presence of certain modifiers, this reading may be available:

(39) The river was gradually wider for five miles.

(39) seems to have the reading that (38b) lacks. Ultimately, then, it may be that internal comparatives genuinely have the same semantics as their corresponding degree-achievement verbs, i.e. in denoting a property of intervals that exhibit a particular kind of value change; but an exhaustive comparison of internal comparatives and degree-achievement verbs is left for future research.

4. Conclusion

Constructions of internal and external comparison exhibit clear grammatical differences. Internal comparatives can appear with axis-oriented modifiers, while external comparatives may not; and internal comparatives in some contexts may not appear with an explicit *than*-argument. The present analysis treats internal comparatives as expressing a relation between intervals in the domain of their subject, but external comparatives as having the more traditional denotation of a relation between individuals (or sets of degrees in the case of clausal comparatives). On this account, the grammatical differences between internal and external comparatives are reduced to a problem of type mismatch. One consequence of this analysis is that internal comparatives take just one nominal argument, i.e. that no comparatives with overt *than*-arguments are true internal comparatives.

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When additive particles can associate with *wh*-phrases[1]

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Abstract. The distribution of certain additive particles is restricted. It has been suggested that in *wh*-questions they can only associate with the *wh*-phrase if the question receives a showmaster interpretation (Umbach, 2012). I present novel data challenging this generalization and account for these data by lifting Beaver and Clark (2008)'s QUD-based account of additive particles to an inquisitive semantics setting, so that it captures the contribution of additive particles in assertions, polar questions and *wh*-questions.

Keywords: additive particles, questions, showmaster questions, summoning questions, QUD.

1. Introduction

English has several additive particles, which differ in their distribution across sentence types. In this paper, I will focus on *also*, which is a common choice to express additivity in assertions and polar questions:

(1) a. Mary **also** danced.
    b. Did Mary **also** dance?

In *wh*-questions the choice of additive particle depends on the phrase with which the particle associates.[2] If it associates with a non-*wh*-phrase, as in (2), then the use of *also* is acceptable; but if it associates with the *wh*-phrase, as in (3a), then the use of *also* is marked—we will discuss how exactly it is marked in the following section. In order to express additivity in this latter case, speakers typically employ *else*, as in (3b).

(2) Lots of people danced the WALTZ. But who **also** danced the JIVE?

(3) a. JOHN danced the waltz. #Who **also** danced the waltz?
    b. JOHN danced the waltz. Who **else** danced the waltz?

This paper investigates under which circumstances it is acceptable for *also* to associate with a *wh*-phrase. We will derive the basic distributional properties of *also* and *else* and discuss how these properties interact with certain non-canonical questioning scenarios.

The paper is structured as follows. Section 2 introduces the key data. Section 3 provides some background on additive presuppositions and the question-under-discussion model in which the account will be formulated. In Section 4 a generalized additive presupposition is proposed, and in Section 5 it is demonstrated how this presupposition accounts for the distribution of *also* in assertions, polar questions and different kinds of *wh*-questions. Section 6 concludes.

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[2]To be precise, in assertions and polar questions, the acceptability of *also* depends on the associated phrase as well: e.g., *also* is marked when it associates with non-specific indefinite phrases or universal quantifiers. While the current paper doesn't focus on these data points, they are predicted, both on Beaver and Clark (2008)'s account, introduced in Section 3, and on the account proposed here.

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2. *Also* in showmaster questions and summoning questions

There are several recent papers that discuss the differences between the two German additive particles *auch* and *noch* (Umbach, 2012; Grubic, 2017: also see Eckardt, 2006).[3] Though these accounts are concerned with data from German, they are immediately relevant for us, since, as we will see, the pertinent differences between *auch* and *noch* correspond to those between *also* and *else*. Here I discuss a generalization about *auch* due to Umbach (2012) and challenge it on the basis of previously unnoticed data.

2.1. Showmaster questions

Umbach (2012) maintains that *auch* can only associate with the *wh*-phrase in a *wh*-question if the question is interpreted as a *showmaster question*, i.e., a question the speaker asks while already knowing the answer. Typically, a speaker will ask a showmaster question in order to prompt the hearer to say the answer out aloud. As an illustration, Umbach provides the example in (4), which involves three people, Little Lisa, Lisa's mother, and Auntie. Since Auntie has been to the zoo with Lisa, she knows the answer to the question in (4); she is merely trying to prompt Lisa to tell her mother the answer too.

(4) [Little Lisa tells her mother what happened when she visited the zoo with Auntie.]
Auntie to Lisa: Und was ist im Zoo auch passiert?
Auntie to Lisa: And what also happened at the zoo? (Umbach, 2012: 1845)

Observe that *auch* is acceptable in (4), although it associates with the *wh*-phrase. English *also* patterns with *auch*: the English translation of (4) receives a showmaster interpretation and it seems to be this interpretation that makes *also* acceptable.

Other possible scenarios for showmaster questions include oral examinations, as in (5), or lively narrative discourses such as (6). Again, both *auch* and *also* are acceptable in these examples.

(5) [Examiner after student has given an incomplete answer:]
Gut, aber was ist 1776 auch passiert?
Good, but what also happened in 1776?

(6) Ich stand vor dem Eingang, und wer stand da plötzlich auch?
I was standing in front of the entrance, and who also stood there all of a sudden?
(Reis and Rosengren, 1997: quoted from Umbach, 2012)

2.2. Extant accounts of *also* in showmaster questions

Umbach (2012) herself and Grubic (2017) have suggested explanations for why *auch* can appear in showmaster questions. I critically discuss both accounts, starting with Grubic's proposal.

[3] For a recent investigation into the semantics of additive particles in questions, albeit with a different focus than that of the current paper, also see Schmitt (2018).

2.2.1. Grubic (2017)

Grubic's account is formulated in a *question-under-discussion* (*QUD*) framework and treats *auch* as signaling that a previously addressed QUD gets re-opened with respect to a larger *wh*-domain.[4] According to Grubic, the showmaster effect is pragmatic and stems from Gricean reasoning along the following lines. A speaker will only re-open a QUD with respect to a larger *wh*-domain if she has a reason to do so. A plausible reason is that the speaker thinks that in the previously given answer relevant alternatives were forgotten or ignored.

A problem I see with this line of explanation is that it only derives a relatively weak implicature, namely that the speaker considers the existing answer incomplete—not that she already knows the answer to the *auch*-question. This is problematic because a scenario in which the speaker merely thinks the answer is incomplete doesn't seem to license *auch*. For instance, in (7), if B merely considers A's answer incomplete but doesn't know which exact books A read over the summer, then it isn't acceptable for B to use *also*.

(7) [Over the summer, every student has to read two books of their choice. Back at school, A is reporting what she read:]
A: On vacation, I read Emma.
B: Okay, cool. #Und was hast du auch gelesen?
B: Okay, cool. #And what did you also read?

2.2.2. Umbach (2012)

Umbach's explanation for the showmaster interpretation is based on the following reasoning. If additive particles associate with a *wh*-phrase, they follow their associated phrase rather than preceding it. This configuration—an additive particle following its associated phrase—shows up not only in questions, but also in assertions (Altmann, 1976), as illustrated in (8).

(8) Mary danced, and John ALSO danced.

Krifka (1998) argues that if an additive particle appears in this configuration, its associated phrase is a *contrastive topic* (cf. Jackendoff, 1972; Büring, 2003). Now, since *auch* in the relevant questions associates with the *wh*-phrase, Umbach concludes that the *wh*-phrase must be a contrastive topic. According to Umbach, contrastive topics need to be referential, but *wh*-phrases are not referential in a suitable way. She concludes that if *auch* associates with the *wh*-phrase, it coerces a referential interpretation of the *wh*-phrase, and that this is the cause of the showmaster interpretation:[5]

[4] I summarize only those features of Grubic's proposal that are relevant for the showmaster effect. Her full account uses situation semantics (Kratzer, 2011) and captures a range of differences between *auch* and *noch*. It treats *auch* as signallig that the QUD gets re-opened with respect to the same *topic situation* but a different *resource situation*. Since Grubic additionally assumes that QUDs cannot get re-opened with respect to the same topic situation and a smaller domain, this means that for her *auch* signals a re-opening of a QUD with a larger domain.

[5] This argument is problematic. In particular, referentiality is not the same as specificity. If the *wh*-phrase refered to a plurality of individuals, e.g., the whole *wh*-domain, then, as far as I can see, it would be referential but the speaker wouldn't know the answer. However, it is indeed an interesting question whether *wh*-phrases can be contrastive topics (CTs), and if so, how this may be derived in a theory of CTs. The problem might be similar to

> "...The wh-word is, as a rule, unsuited to serve as a contrastive topic because it is not referential. However, in showmaster questions the need for a contrastive topic imposes a referential interpretation on the wh-word, which is why these questions presuppose that the speaker is familiar with the answer." (Umbach, 2012: 1858)

This means that Umbach's account predicts a showmaster interpretation to arise whenever *auch* associates with the *wh*-phrase. We are now going to see some novel data not in line with this prediction.

2.3. Summoning questions

Umbach's prediction is too strong. Not all questions in which *auch* associates with the *wh*-phrase receive a showmaster interpretation. A case in point are a certain class of questions, which to my knowledge have not been discussed in the literature so far. I will refer to them as *summoning questions*. A summoning question is a question that typically is posed directly to a group of people, with the aim of finding out who of these people have a certain property.

(9) Who here is taking this course for credit? Raise your hands!

As shown in (10), summoning questions can host *auch/also* without showmaster effect. In (10a) and its English translation, for instance, the question of who wants an ice cream is genuine: the speaker doesn't have anybody particular in mind, contrary to what Umbach's account would predict.

(10) a. Wer will **auch** ein Eis?
*Who **also** wants an ice cream?*
b. Wer ist **auch** dafür zu gehen?
*Who is **also** in favor of leaving?*
c. Wer von euch ist **auch** bei Snapchat?
*Who here is **also** on Snapchat?*

Finally, note that by default the speaker will act as the antecedent for the additive particle in summoning questions. In (10a), for example, the speaker is presupposing that she herself wants an ice cream.[6] However, as illustrated in (11), it doesn't seem necessary for licensing *auch/also* that the speaker is the antecedent.

(11) Ich geh gleich ein Eis für Maria holen. Wer von euch will auch eins?
I'm getting an ice cream for Mary. Who of you guys also wants one?

2.4. Summary of the data

Let's recap the empirical picture. We have seen that, while *also/auch* can easily appear in assertions and polar questions, these particles are only acceptable in a canonical *wh*-question if they don't associate with the *wh*-phrase. If they do associate with this phrase, they are only

that posed by generalized quantifiers acting as CTs (Rooth, 2005; Constant, 2014; Chapter 4).

[6]It's an interesting question, though probably orthogonal to our purposes here, why additive presuppositions in summoning questions can be accommodated so easily, whereas they have been observed to resist accommodation in other environments (Kripke, 1991/2009).

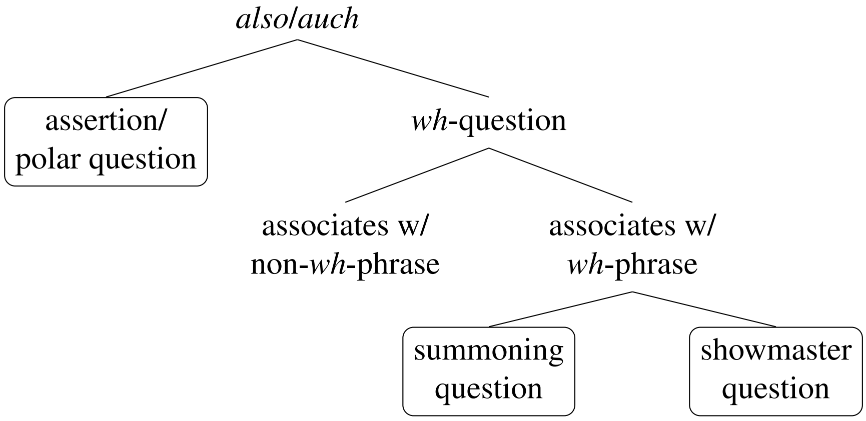


Figure 1: Distribution of *also*/*auch*

acceptable if their containing question is a summoning question or a showmaster question. This distribution is summarized in Figure 1.

In this paper, we will only account for a subset of these data, leaving aside for now the case where *also*/*auch* appears in a *wh*-question but associates with a non-*wh*-phrase (that is, we will account for all the boxed cases in Figure 1).

3. Background on additive presuppositions

Before turning to our positive proposal in the next section, we will review some basic properties of additive particles and see how these properties can be captured in a QUD framework.

3.1. Focus sensitivity

Additive particles are focus-sensitive. Their presupposition depends on the focus structure of their containing sentence. For example, (12a), where *dog* is focused, presupposes that John gave something other than a dog to Mary, while (12b), where *Mary* is focused, presupposes that John gave a dog to someone other than Mary.

(12) a. John also gave a $[\text{dog}]_F$ to Mary.
$\rightsquigarrow$ John gave something other than a dog to Mary.
b. John also gave a dog to $[\text{Mary}]_F$.
$\rightsquigarrow$ John gave a dog to somebody other than Mary.

This focus sensitivity can easily be implemented in alternative semantics (Rooth, 1992): if *also* appears in a sentence *S*, then it presupposes that there is a true alternatives *p* in the focus semantic value of *S* such that *p* is different from the ordinary semantic value of *S*. We will refer to the first part of this presupposition as the EXISTENCE condition and to the second part as the NON-IDENTITY condition. For example (12b) above, these conditions amount to the following.

(13) John also gave a dog to MARY.
$\rightsquigarrow \underbrace{\text{There's a true } p \in [\![\text{John gave a dog to MARY}]\!]^F}_{\text{EXISTENCE}} \text{ s.t. } \underbrace{p \neq [\![\text{John gave a dog to MARY}]\!]^0}_{\text{NON-IDENTITY}}$

It has been suggested in the literature that this formulation falls short, though: both EXISTENCE and NON-IDENTITY have been argued to be too weak to capture the empirical picture.

3.2. EXISTENCE is too weak

Kripke (1991/2009) points out that additive presuppositions are different from many other presuppositions: they can't be accommodated or satisfied by common ground knowledge. If they could be, then we would expect (14) to be acceptable out of the blue—after all, it is well known that, any given night, several million people have dinner in New York. So, if the additive presupposition was just an existential statement, it could easily be accommodated.

(14) Sam is having dinner in New York tonight, too. (Kripke, 1991/2009)

Kripke suggests that additive particles, rather than contributing a simple existential statement, are anaphoric: in (14), *too* seems to require that, of some particular individual other than John, it has been saliently established in the discourse that they are having dinner in New York tonight.

3.3. Focus sensitivity via Current Question

Beaver and Clark (2008) suggest a way of capturing the discourse anaphoricity and focus sensitivity of additive particles in a question-under-discussion-based framework (Roberts, 1996). In this framework, focus sensitivity can be modeled without directly making reference to focus semantic values. Instead, it is assumed that every assertion addresses a so-called *Current Question* (*CQ*). This CQ can either be an explicitly asked question or it can remain implicit. In the latter case, it can be deduced from the focus structure of the assertion. This is possible because of *question-answer congruence*: if an assertion A answers a question Q, then A has focus marking on that constituent that corresponds to the *wh*-phrase in Q. For example, (15) is taken to be associated with the CQ *What did Mary give John?*, whereas (16) is taken to be associated with the CQ *Who gave John a dog?*.

(15) [CQ: **What** did Mary give John?]
Mary gave John a [dog]$_F$.

(16) [CQ: **Who** gave John a dog?]
[Mary]$_F$ gave John a dog.

This connection between focus marking and CQ allows Beaver and Clark to capture the EXISTENCE condition in terms of the CQ. Roughly, they take an additive particle to signal that a positive partial answer to the CQ has saliently been established in the discourse. For example, *also* in (17) is taken to mark that a positive partial answer to *What did John read?* has saliently been established.

(17) [CQ: **What** did John read?]
John also read [Middlemarch]$_F$.

3.4. NON-IDENTITY is too weak

The NON-IDENTITY condition as formulated in Section 3.1 has also been subject to criticism, with both Jasinskaja and Zeevat (2009) and Beaver and Clark (2008) proposing a strengthened version of this condition. Beaver and Clark require that the already established partial answer, i.e., the antecedent, is not entailed by the prejacent of the additive particle. To motivate this decision, they refer to on the oddness of discourses like those in (18).

(18) a. Sam is [happy]$_F$. #He's also [ecstatic]$_F$. (after Beaver and Clark, 2008)

b. I called [Alice]$_F$. #I also called [Alice and Mary]$_F$.

c. Alice [sang]$_F$. #She also [sang beautifully]$_F$.

These are all cases where the prejacent of the additive particle entails the antecedent. Observe that with entailment in the opposite direction, however, the discourse is degraded too:

(19) a. Sam is [ecstatic]$_F$. #He's also [happy]$_F$.
b. I called [Alice and Mary]$_F$. #I also called [Mary]$_F$.
c. Sam has a [brother and a sister]$_F$. #He also has [siblings]$_F$.

One might think that these data can be explained as cases of redundancy. But the degradedness seems to persist even if we take care to construct non-redundant discourses, e.g., discourses that guide through a reasoning process step by step or explain the meaning of a word:

(20) a. Sam is [ecstatic]$_F$. That means that he is (?#also) [happy]$_F$.
b. I called [Alice and Mary]$_F$. This means in particular that I (#also) called [Mary]$_F$.
c. Sam has [a brother and a sister]$_F$. That means that Sam (#also) has [siblings]$_F$.

Leaving out the additive particle does seem to improve acceptability, which suggests that the problem is indeed caused by the additive particle. I conclude that the non-identity condition needs to be strengthened into both directions: prejacent of the additive particle and antecedent need to be logically independent.

This concludes our discussion of additive particles in assertions. In the following section, we will formulate a generalized and strengthened version of Beaver and Clark's account. It will be *generalized* in that it can apply not only to additives in assertions, but also in polar questions and *wh*-questions; and it will be *strengthened* in that it implements the NON-IDENTITY condition in terms of logical independence.[7]

4. Generalizing the additive presupposition

4.1. Resolutions and positive partial resolutions

To formulate a unified additive presupposition, we will borrow some notions from inquisitive semantics (Ciardelli et al., 2019).[8]

[7]For related work that is concerned with lifting the account of another kind of focus-sensitive expression, namely exclusive particles, to an inquisitive semantics setting, see Möller Kalpak (2018). A comparison of this approach with the one proposed here must be left for future work.

[8]This choice is motivated by conceptual reasons. Inquisitive semantics is a framework specifically designed to deliver a uniform notion of meaning for declarative and interrogative sentences. Adopting this notion here will

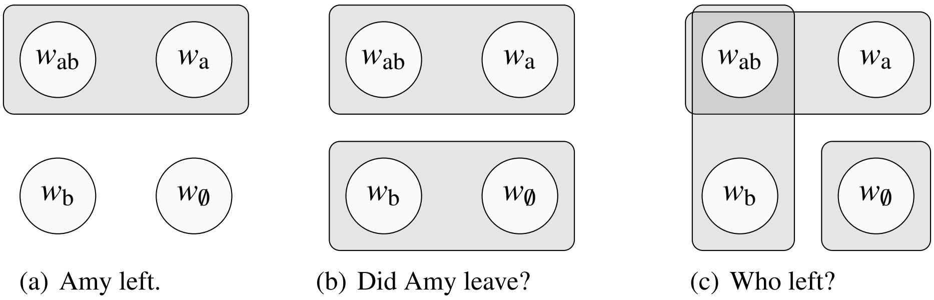


Figure 2: Examples of sentence meanings in inquisitive semantics.

4.1.1. Resolutions

In inquisitive semantics, the meaning of both declaratives and interrogatives is construed as the same kind of semantic object, namely a set of propositions. By uttering a sentence with meaning P, a speaker is taken to raise an issue whose resolution requires establishing one of the propositions in P, while at the same time providing the information that the actual world is contained in the union of these propositions, $\bigcup P$. We call the elements of P *resolutions* of the sentence. The difference between declaratives and interrogatives is that, by uttering a declarative, a speaker raises a trivial issue, i.e., she provides enough information in order to resolve the issue she raises. Uttering an interrogative sentence, by contrast, raises a non-trivial issue.

Sentence meanings in inquisitive semantics are *downward closed*: if $p \in P$ and $q \subset p$, then also $q \in P$. This captures the intuition that, if a proposition p resolves a given issue, then any stronger proposition $q \subset p$ will also resolve that issue. Given a set of propositions P, we call $P^{\downarrow} = \{p \mid \exists q \in P : p \subseteq q\}$ the *downward closure* of P.

To illustrate these notions, consider the following three sentences:

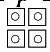
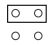
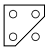
(21) a. Amy left.
b. Did Amy leave?
c. Who left?

Assuming a domain with exactly two individuals, Amy and Bill, these sentences may be assigned the meanings depicted in Figure 2, where w_{ab} and w_a are worlds where Amy left, w_b and $w_\emptyset$ are worlds where Amy didn't leave, w_{ab} and w_b are worlds where Bill left, and w_a and $w_\emptyset$ are worlds where Bill didn't leave. The shaded rectangles are the least informative propositions contained in the given meanings. By downward closure, all propositions contained in one of these alternatives are also included in the meanings of the sentences.

4.1.2. Positive partial resolutions

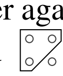
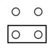
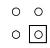
For our account of additive particles, we won't use resolutions simpliciter, but a closely related notion that we will refer to as *positive partial resolutions*.

provide a stronger conceptual underpinning for the proposed account. It is not a technical necessity, however: the same predictions could in principle be achieved without using concepts from inquisitive semantics.

Partial resolutions. A *partial resolution* is to a resolution what a partial answer is to an answer: to be a partial resolution of a sentence S, a proposition p doesn't have to resolve the issue raised by S completely, but it is sufficient if p rules out some resolution in the meaning of S. For instance, consider the sentence meaning  . Among its partial resolutions are  ,  and  , none of which however are resolutions.

To see why partial resolutions are the relevant notion when it comes to modeling additive presuppositions, consider (22). In both examples, the use of the additive particle is licensed by a merely partial resolution.

(22) a. Alice invited John or Mary, I don't remember which. She also invited Bob.
b. Someone from your soccer team called. Your grandmother also called.

Positive partial resolutions. Intuitively, a *positive partial resolution* is a resolution that partially resolves a given issue positively. In the case of a polar question, it is a non-empty resolution entailing the *yes*-reply. A positive partial resolution of a *wh*-question is a non-empty partial resolution entailing a *somebody*/*something*-reply. For instance, consider again the sentence meaning  . Examples of positive partial resolutions are  ,  and  . Examples of propositions that are partial resolutions but not *positive* partial resolutions are  and  .

To see why positive partial resolutions are needed for licensing additive particles, consider (23). In the first sentences of both examples, the CQ gets (partially) resolved, but not positively. As a consequence, the use of an additive particle is not acceptable.

(23) CQ: Who called?
a. John didn't call. #Alice also called.
b. Nobody called. #Alice also called.

To give a formal definition of positive partial resolutions, we need one additional concept, namely that of *highlighting* (see, e.g., Roelofsen and Farkas, 2015). This notion is used to capture which semantic objects a sentence makes salient.[9] For example, both the polar interrogative in (24a) and the declarative in (24b) are taken to highlight the proposition that Ann watched Psycho, i.e., $\lambda w.W(p)(a)(w)$. The single-*wh*-question in (24c) is taken to highlight the 1-place property of having been watched by Ann, i.e., $\lambda x.\lambda w.W(x)(a)(w)$, and the multiple-*wh*-question in (24d) is taken to highlight the relation $\lambda y.\lambda x.\lambda w.W(x)(y)(w)$.

(24)	a.	Ann watched Psycho.	$\rightsquigarrow \lambda w.W(p)(a)(w)$	0-place property
	b.	Did Ann watch Psycho?	$\rightsquigarrow \lambda w.W(p)(a)(w)$	0-place property
	c.	What did Ann watch?	$\rightsquigarrow \lambda x.\lambda w.W(x)(a)(w)$	1-place property
	d.	Who watched what?	$\rightsquigarrow \lambda y.\lambda x.\lambda w.W(x)(y)(w)$	2-place property

We can generalize over these different cases by viewing propositions as 0-place properties. All of the above sentence types then highlight an n-place property, where $n \geq 0$ is the number of *wh*-elements in the sentence.

[9]The idea that uttering a question makes certain semantic objects salient, which become available for anaphoric reference, has been used in several theories of questions (Groenendijk and Stokhof, 1984; von Stechow, 1991; Krifka, 2001; Aloni et al., 2007). Here, we use Roelofsen and Farkas (2015)'s implementation of this idea, which applies to both questions and assertions, and was motivated by the licensing patterns of polar particle responses.

With the notion of highlighting in place, we can now formally define the set of positive partial resolutions of a sentence S. Let $f : D_e^n \to D_{\langle s,t\rangle}$ be the n-place property highlighted by S. Then the set P of positive partial resolutions of S is:

$$P = \{\, f(\vec{d}_i) \cup \cdots \cup f(\vec{d}_j) \mid \vec{d}_i, \ldots, \vec{d}_j \in D^n\}^{\downarrow} \setminus \{\emptyset\}$$

4.2. A generalized additive presupposition

We are now ready to formulate a generalized version of the additive presupposition.

If an additive particle occurs in a sentence S, this presupposes that:

- a positive partial resolution p of the CQ has saliently been established, and **EXISTENCE**
- there is no positive partial resolution q of S such that $q \subseteq p$. **NON-IDENTITY**

Sentence S can be a declarative, a polar interrogative or a *wh*-interrogative. In the remainder of this section, we will check which predictions the presupposition makes for these different cases.

Declaratives. Let's consider the example in (25). As we have seen in Section 3.3, this sentence addresses the CQ *What did John read?*. So, the EXISTENCE condition requires there to be a saliently established positive partial resolution p of *What did John read?*.

(25) John also read [Middlemarch]$_F$.

To find out what the NON-IDENTITY condition amounts to, we first have to determine the set of positive partial resolutions of (25). This set contains the proposition m that John read Middlemarch and all non-empty subsets of m. The NON-IDENTITY condition requires that none of these positive partial resolutions entail p. This is equivalent to requiring that p and m are logically independent.[10] So, we predict (25) to presuppose that there is a positive partial resolution p of the question what John read and that p is logically independent of the proposition that John read Middlemarch. Hence, for declaratives, the generalized version of the additive presupposition boils down to a classical additive presupposition (albeit in terms of logical independence).

Polar interrogatives. Let's consider example (26), the polar interrogative analogue of (25). We will see that, in all relevant respects, it behaves like (25).

(26) Did John also read [Middlemarch]$_F$?

It seems to be a natural assumption (and in line with Roberts 1996's way of computing coherence) that (26) is part of a strategy for finding an answer to the *wh*-question *What did John read?*. As illustrated below, this latter question can be split up into a series of polar questions of the form *Did John read X?* such that if we know the answer to all the polar questions, we

[10]The full line of reasoning is as follows. We know that no positive partial resolution of S entails p, i.e., for all $m' \subseteq m$, $m' \not\subseteq p$ and in particular $m \not\subseteq p$. Since p is a *positive* partial resolution, we also know that $p \neq \emptyset$. Hence, for all $m' \subseteq m$, $m' \neq p$. That is, $p \not\subseteq m$. So, we have $m \not\subseteq p \not\subseteq m$, i.e., p is logically independent of m.

will also know the answer to *What did John read?*. For this reason, I will assume that *What did John read?* is the CQ of (26).[11]

CQ: **What** did John read?

Did John read [**Emma**]$_F$?　　Did John read [**Middlemarch**]$_F$?　　...

Note that a principle similar to question-answer congruence is in place here: the focus-marked constituent in the polar questions corresponds to the *wh*-phrase in the CQ. This means that an assertion and its corresponding polar question have the same CQ. Furthermore, because an assertion and its corresponding polar question highlight the same proposition, they also have the same set of positive partial resolutions. So, for polar questions the generalized additive presupposition amounts to exactly the same as for assertions. For example, just like the assertion in (25), the polar question in (26) presupposes that there's a saliently established positive partial resolution *p* of *What did John read?* such that *p* is logically independent of the proposition that John read Middlemarch.

***wh*-interrogatives.** Just as with polar questions, we first have to think about how *wh*-questions relate to the CQ. We have seen earlier that the CQ can remain implicit. However, it can of course also be asked explicitly—and I think it makes sense to assume that this is what *wh*-questions without an overt domain restriction (at least in the absence of narrow focus) usually do.[12] For instance, I will assume that the unrestricted *wh*-question in (27) is part of a strategy to answer the CQ *What did John read?*, i.e., the *wh*-question itself specifies the CQ.

(27) [CQ: What did John read?]
What did John read?

I further assume that adding an expression like *also*, which doesn't contribute to the at-issue question meaning, doesn't have an effect on the associated CQ. That is, I take (28) to have the same CQ as (27).

(28) [CQ: What did John read?]
#What did John **also** read?

The fact that CQ and overtly asked question *S* are identical is crucial for our account of why *also* is marked in (28). The EXISTENCE condition requires that there is a saliently established positive partial resolution *p* of the CQ, i.e., of the question what John read. The NON-IDENTITY condition requires that this *p* is not entailed by any positive partial resolution *q* of *S*, i.e., of the question what John read. It is impossible to find a *p* that satisfies these two conditions: since *S* and the CQ are idential, whenever a proposition *p* is a positive partial resolution of the CQ,

[11] More work needs to be done to determine when exactly polar questions are part of a strategy to answer a *wh*-CQ, and when they are simply "their own CQ".
[12] We will discuss *wh*-question with domain restrictions in Section 5.

it is trivial to find a positive partial resolution q of S such that $q \subseteq p$, namely $q = p$. I take this impossibility to satisfy the additive presupposition to explain why *also* is marked in (28).

On an intuitive level, we might think of the problem as follows. When an additive particle appears in a *wh*-question and associates with the *wh*-phrase, then the NON-IDENTITY condition is much more demanding than when the particle appears in an assertion or polar question. This is because assertions and polar questions highlight a concrete proposition, and NON-IDENTITY only requires this proposition to be independent of the antecedent proposition p. By contrast, a *wh*-question doesn't "mention" a concrete proposition, but rather highlights an n-place property with $n \geq 1$. This means for a *wh*-question there are usually several different positive partial resolutions, all of which are required by NON-IDENTITY to be independent of p.

To take stock, so far we have accounted for the markedness of *also* in canonical unrestricted *wh*-questions. What remains to be done is to explain why *also* is acceptable in summoning and showmaster questions, and why *else* is acceptable in canonical *wh*-questions.

5. Ways of ensuring NON-IDENTITY

As we have seen, canonical unrestricted *wh*-questions are taken to coincide with their CQs. As a consequence, it becomes impossible to satisfy the NON-IDENTITY condition for these questions. In this section, we will discuss how *else*-marked *wh*-questions and different kinds of non-canonical *wh*-questions circumvent this problem. The crucial difference will be that with these question types the overtly asked question and the CQ are not identical, but that the CQ is a proper superquestion of the overtly asked question.

5.1. *Else*-questions and witness removal

For simplicity, we will treat *else* as an additive particle here (following Schwarz, 2017). This is motivated by the fact that, just like a bona fide additive particle, *else* in *wh*-questions gives rise to an additivity inference, as illustrated in (29b).[13]

(29) Who danced?
  a. John danced. Who **else** danced?
  b. John didn't dance. #Who **else** danced?

So, we assume that *also* and *else* contribute the same additive presupposition. What then is the relevant difference between the particles? I suggest it is that *else* but not *also* modifies the *wh*-domain of its containing question by removing the witness of the additive presupposition from that domain (Romero, 1998; Harris, 2014; Schwarz, 2017). For instance, in (30), Mary is removed from the *wh*-domain. The resulting question is what Eckardt (2006) calls a *remnant question*.

[13]Note that if *else* associates with an indefinite rather than with a *wh*-phrases, this doesn't seem to give rise to the same inference, as shown in (i). This suggests that *else* doesn't conventionally trigger an addivity presupposition. In this paper, I treat *else* as an additive particle for reasons of exposition: assuming *else* is maximally similar to *also* makes it easier to discuss which difference between the two is relevant for the difference in their behavior in *wh*-questions. As far as I can see, nothing in the proposed account of *also* will hinge on the assumptions about *else*.

(i) John didn't dance, but someone else did.

(30) A: Mary called.
B: Who else called? = Who other than Mary called?

Further evidence for this difference between *also* and *else* comes from the contrast in (31), where the speaker is the witness. In (31a), *else* tries to remove the witness from the *wh*-domain. With the *of you* restriction, however, the witness is not in the domain in the first place, which means the witness removal fails. I take this to explain why *else* is marked with the *of you* restriction.[14] By contrast, this problem doesn't arise with the *of us* restriction, because with this restriction the witness is contained in the domain. Turning to (31b), the *of you* restriction is acceptable with *also* because *also* doesn't remove the witness from the *wh*-domain. Finally, the *of us* restriction is marked with *also* for the reason discussed in Section 4.2 above: the NON-IDENTITY condition can't be satisfied.

(31) I can juggle…
a. Who else of **us/#you** can juggle?
b. Who of **#us/you** can also juggle?

Let's now have a look at why *else*, unlike *also*, can appear in canonical unrestricted *wh*-questions. In a nutshell, it will be the witness removal that saves *else* in these questions, by guaranteeing that the NON-IDENTITY condition can be met.

In order to see what the generalized additive presupposition amounts to for *else*-questions, we first have to see how such questions relate to the CQ. An *else*-question Q is a subquestion of the corresponding question without *else*, Q' (if one knows a complete answer to Q', one also knows a complete answer to Q). For this reason, Q is part of a strategy to answer Q' (cf. Eckardt, 2006). I take an *else*-question to have the corresponding non-*else* question as its CQ:

CQ: **What** did John read?

John read [**Middlemarch**]$_F$. | **What else** did John read? | …

Crucially, this means that for *else*-marked *wh*-questions—unlike for unrestricted *wh*-questions—the CQ is different from the question itself. In particular, the antecedent proposition p is not a positive partial resolution of the *else*-question. This fact makes it possible to satisfy NON-IDENTITY. To see why, consider the question *What else did John read?*, and assume that the domain consists of Middlemarch, Emma and Frankenstein. According to the generalized additive presupposition, *else* signals that there is a proposition p such that:

– p is a saliently established partial resolution of *What did John read?* (=*Which of Middlemarch, Emma and Frankenstein did John read?*), and EXISTENCE

[14] An analogous explanation can be given to the following example from Eckardt (2006: 86). If *noch* is like *else* in that it removes the witness from the *wh*-domain, then the markedness of (ib) is predicted: the witness(es), namely the coffee drinker(s) from table 1, are not in the *wh*-domain, and hence can't be removed.

(i) Waitress first takes orders for coffee at table 1. Turning then to table 2, she asks:
a. Wer an diesem Tisch will AUCH Kaffee? (*Who at this table wants coffee, too?*)
b. #Wer an diesem Tisch will NOCH Kaffee? (*Who at this table wants* NOCH *coffee?*)

– there is no positive partial resolution q of *What* ***else*** *did John read?* (=*Which of Emma and Frankenstein did John read?*) such that $q \subseteq p$. NON-IDENTITY

Because Middlemarch is not in the domain of *What else did John read*, it is easy to find a proposition p satisfying the above conditions. We can simply choose p to be the proposition that John read Middlemarch. More generally, it is the presence of the witness in the *wh*-domain of unrestricted *wh*-questions that prevents NON-IDENTITY from being satisfiable. So, since *else* removes precisely the witness from the domain, with *else*-questions it will always be possible to satisfy NON-IDENTITY.

5.2. Summoning questions and domain restriction

If witness removal can save NON-IDENTITY, we would expect domain restriction more generally to be able to do the same: *also* should be acceptable in *wh*-questions whose domain has been restricted so as to not contain the witness. Consider example (32), where John is the witness. If we assume that John is not in the hearer's dorm, then the domain restriction *from your dorm* ensures that the *wh*-domain doesn't contain the witness. Indeed, adding this overt domain restriction in (32), seems to improve the acceptability of *also*.

(32) John danced all night at Mary's birthday party. Who #(from YOUR dorm) also danced?

Now, I suggest that in summoning questions a suitable restriction doesn't have to be spelled out overtly—because it is already supplied by the setup of the context. If a speaker addresses a group using a summoning question, she restricts the *wh*-domain to that group. In (33), for example, the *of you guys* restriction doesn't change the meaning of the question since the *wh*-domain would be understood to consist of the hearers even without the overt restriction.

(33) I'm getting an ice cream. Who (of you guys) also wants one?

Crucially, since the speaker is the witness in (33), the *wh*-domain doesn't contain the witness. This means that NON-IDENTITY can be satisfied, and *also* is acceptable in summoning questions.

Finally, it seems that the acceptability of *also* improves more through certain domain restrictions than others. For instance, the contextual restriction in summoning questions seems to "work better" than the overt one in (32). Those restrictions that seem to improve the acceptability of *also* the most have one thing in common: they guarantee that the witness is not contained in the *wh*-domain without relying on world knowledge. This can happen, as in *else*-questions, through grammaticalized strategies for removing the witness, or, as in summoning questions, through splitting up a situation into speaker and hearers, two groups that are guaranteed to be disjoint. By contrast, whether the witness is contained in the *wh*-domain in (32) depends on whether John is in the hearer's dorm, i.e., it depends on contingent facts about the world.

5.3. Showmaster questions and domain restriction

As we have seen, the mechanisms that allow NON-IDENTITY to be satisfied in the case of *else*-questions and summoning questions are closely related: they both result in a *wh*-domain that doesn't contain the witness. In this subsection, I will outline an account of showmaster questions on which the acceptability of *also* in these questions is explained on the basis of domain restriction as well. There are, however, problems with this account, also to be discussed below.

The characteristic property of a showmaster question is that the speaker already has a particular answer to this question in mind. George (2011) treats questions with this property as cases of extreme domain restriction: the speaker restricts the domain to a singleton set containing only that entity she has in mind.[15] In particular, George uses the following trivia question to argue for this treatment.

(34) a. What was considered a sin in the 16th and 17th century?
  b. Eating chocolate.

> "[T]here are certainly many other things that were considered sins in the centuries in question. ... [W]e understand [(34a)] as a question about which activity or activities in some suitably restricted domain was or were considered sinful, but, in the context of a trivia card, we have no way of knowing what this domain might be – the question becomes a game not of testing our trivia knowledge, but of asking us to guess which sin the author of the question was thinking of."
> (George, 2011: 208f)

If we adopt George's account, the acceptability of *also* falls out straightforwardly, since, from the perspective of the additive presupposition, questions with singleton domains behave just like assertions. For example, recall the zoo scenario from Section 2.1 and assume that the particular answer Auntie has in mind is that a giraffe stole Lisa's hat. Then the meaning of Auntie's question contains just a single alternative, namely the proposition that a giraffe stole Lisa's hat:

(35) $[\![\text{What also happened at the zoo?}]\!] = \{\,\textbf{giraffe-stole-lisa's-hat}\,\}^{\downarrow}$

Hence, the generalized additive presupposition for (35) boils down to the same as for the assertion *A giraffe stole Lisa's hat* or the polar question *Did a giraffe steal Lisa's hat?*. This means that, just as with assertions and polar questions, satisfying NON-IDENTITY is unproblematic here, and *also* is predicted to be acceptable.

However, there are a number of problems with the extreme domain restriction account of showmaster questions. A concrete data point challenging this account are multiple-choice questions like (36). Such questions, although they are generally showmaster questions, make their domain fully explicit by listing all possible answers. This doesn't fit with the assumption that the domain is restricted to just the answer(s) the speaker has in mind.[16]

(36) What was considered a sin in the 16th and 17th century? Was it:
  (A) eating chocolate (B) hiding chocolate eggs
  (C) making chocolate without the Queen's permission (D) feeding chocolate to a dog.

[15] George doesn't explicitly mention the term 'showmaster question', but discusses two special cases of these questions: (i) trivia questions and (ii) examples like (i), where the speaker has a particular answer to the embedded question in mind.

(i) Do you know what's awesome?

[16] Thanks to Matthijs Westera for this observation and lovely example.

A more general problem is the following. If we treat showmaster questions as cases of extreme domain restriction, their meaning only contains a single alternative, which makes them indistinguishable from assertions, at least qua their semantic content. This is problematic because much recent work on discourse dynamics is built on the assumption that the discourse effects of an utterance (at least in the absence of special marking) are derivable from its semantic content (e.g. Roberts, 1996; Portner, 2004; Farkas and Bruce, 2010; Murray, 2010). Work in this tradition might, e.g., assume that by uttering a sentence φ whose meaning contains several alternatives a speaker proposes to make $[\![\varphi]\!]$ the QUD; and if this proposal gets accepted, the hearers are required to work towards answering this QUD. By contrast, if a speaker utters a sentence φ whose meaning contains just a single alternative, she proposes to update the common ground with $[\![\varphi]\!]$. Now, if we treat showmaster questions in terms of extreme domain restriction, their meaning contains just a single alternative, and they will be predicted to have the same discourse effect as an assertion. Of course, this doesn't match what we find empirically, since showmaster questions do require the hearer to answer the question.

It seems that what we need instead of the extreme domain restriction account is an account on which the meaning of a showmaster question *restricted to the speaker's epistemic state* contains just a single alternative, while restricted to merely the common ground it still contains multiple alternatives. One way in which this can be achieved is by treating the property of "being the thing the speaker has in mind" not as the domain restriction, but as part of the question proper. That is, we assume that the showmaster question *What happened at the zoo?* can be paraphrased as (37). While $[\![(37)]\!]$ restricted to the common ground still contains several alternatives, it only contains a single alternative when restricted to the speaker's epistemic state.

(37) What thing that happened at the zoo do I have in mind?

This treatment, in combination with a slightly modified version of the NON-IDENTITY condition can still account for the distribution of *also*. Concretely, we change the NON-IDENTITY condition to require that for all *true* positive partial resolutions q of S, $q \not\subseteq p$ (rather than for *all* positive partial resolutions). Then, if we treat showmaster questions in terms of paraphrases like (37), the speaker knows which positive partial resolutions are true. So, she only needs to guarantee that these true positive partial resolutions are logically independent of p, which allows the NON-IDENTITY condition to be satisfied.

However, this account faces a problem as well. If we treat showmaster questions as paraphrases like *What thing that... do I have in mind?*, then we would also expect them to allow the same answer patterns as these paraphrases. This expectation isn't borne out, however. In (38), the negative answer by A seems fine, while in (39) it doesn't. In (39), it seems that A would have to acknowledge that B's reply is an answer to the question—just not the one she had in mind.

(38) A: What thing that happened at the zoo do I have in mind?
B: An elephant sneezed.
A: Wrong!/That's false.

(39) A: What also happened at the zoo?
B: An elephant sneezed.
A: #Wrong!/#That's false.

In sum, we have seen two possible accounts of showmaster questions. Each of them manages to capture the felicity of *also* in these questions, but each comes with problems. Finding a solution is left for future work.

6. Conclusion

I have proposed a generalized additive presupposition that captures the contribution of additive particles in assertions, polar questions, and *wh*-questions, and which accounts for the restricted distribution of *also* across these sentence types. The generalized additive presupposition requires that there is a saliently established positive partial resolution of the CQ which satisfies the generalized NON-IDENTITY condition. While with assertions and polar questions, this condition is satisfiable, with additive particles that associate with *wh*-phrases of canonical unrestricted *wh*-questions, NON-IDENTITY is impossible to satisfy. There are, however, circumstances under which NON-IDENTITY is satisfiable with *wh*-questions, namely either if the *wh*-domain is suitably restricted (as happens, e.g., in summoning questions), or if the speaker knows which positive partial resolutions of the *wh*-question are true (as happens with showmaster questions).

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On the information structure sensitivity of projective content[1]

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Abstract. This paper presents the findings of an experiment designed to investigate the information structure sensitivity of the projective contents associated with *again, stop* and manner adverbs. In contrast to the prejacent of manner adverbs, whose projectivity is expected to be sensitive to information structural focus (e.g., Abrusán, 2013a; Stevens et al., 2017), that of the prejacent of *again* is not (e.g., Beck, 2006; Abrusán, 2013b). We also investigated the pre-state content associated with *stop* because projection analyses differ in their predictions regarding the sensitivity of this projective content to information structural focus (e.g., Heim, 1983; van der Sandt, 1992; Kadmon, 2001; Simons, 2001; Abrusán, 2011, 2016; Romoli, 2011, 2015). We found that the projectivity of all three contents is sensitive to prosodically marked focus and discuss the implications of our findings for empirically adequate projection analyses.

Keywords: projective content, presuppositions, *stop, again*, manner adverbs, focus, prosody

1. Introduction

Projective content is utterance content that is said to 'project' over entailment-canceling operators; that is, projective content is utterance content that listeners may take speakers to be committed to even when the expression associated with the content occurs in an entailment-canceling environment (e.g., Chierchia and McConnell-Ginet, 1990; Potts, 2005; Beaver, Roberts, Simons, and Tonhauser, 2017). To illustrate, consider the examples in (1) and (2). A speaker who utters the sentence in (1a) is typically taken to be committed to the content that Sam visited Barcelona at least once before July 2018. Because a speaker who utters the polar question variant in (1b) may also be taken to be committed to this content, this content is considered projective content. Similarly, a speaker who utters the manner adverb sentence in (2a) with prosodic prominence on the manner adverb *wildly* (indicated by capital letters) is typically taken to be committed to the content that Sam shouted. Because a speaker who utters the variant in (2b) may also be taken to be committed to this content, it is considered projective.

(1) a. In early July 2018, Sam visited Barcelona again.
    b. Did Sam visit Barcelona again in early July 2018?

(2) a. At the dinner party, Sam shouted WILDLY.
    b. Did Sam shout WILDLY at the dinner party?

Why is some utterance content projective and how can projectivity be formally derived? Over the past decades, several different answers have been given to these questions (for overviews

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see, e.g., Kadmon, 2001; Simons et al., 2010; Geurts and Beaver, 2014, and references therein). On one of the most widely adopted analyses, content is projective because it is lexically specified as presupposed: this means that the content must be entailed by or satisfied in the common ground of the interlocutors prior to interpretation of the sentence that realizes the triggering expression (e.g., Heim, 1983; van der Sandt, 1992). Such a lexicalist analysis is often adopted for the projective content associated with *again* (or German *wieder* 'again'; e.g., Kamp and Rossdeutscher, 1994; Fabricius-Hansen, 2001; Simons, 2001; Jäger and Blutner, 2003; van der Sandt and Huitink, 2003; Beck, 2006; but see Abrusán, 2013b, 2016); we henceforth refer to the projective content associated with *again* as the prejacent. Consider, for instance, the lexical entry for *again* proposed by Beck (2006), where t' is an anaphorically retrieved time,[2] p is the content of the sentence radical (that Sam visited Barcelona in (1)), and t and w are the time and world of evaluation, respectively:[3]

(3) $[\![again]\!](t')(p)(t)(w)$ is defined if and only if $p(t')(w)$ & $t' < t$.
If defined, $[\![again]\!](t')(p)(t)(w) = 1$ if and only if $p(t)(w)$.
(adapted from Beck, 2006: 286)

According to this lexical entry, the meaning of (1a) is defined if and only if p, that Sam visited Barcelona, holds at the contextually given time t' and the world of evaluation w, and the contextually given time t' temporally precedes t, here early July 2018. In other words, in (1a), *again* triggers the presupposition that Sam visited Barcelona before early July 2018. If the presupposed prejacent is satisfied in or entailed by the relevant context, (1a) is true if and only if Sam visited Barcelona in early July 2018. Because *again* introduces the same presupposition in the polar question in (1b), a speaker who utters the polar question is likewise predicted to be taken to be committed to Sam having visited Barcelona before early July 2018.

A lexicalist analysis is generally not adopted for the projective content of manner adverbs, which is also referred to as the prejacent; in (2), for instance, the prejacent is that Sam shouted. Instead, the projectivity of the prejacent is derived from focus (e.g., Abrusán, 2013a, Stevens, de Marneffe, Speer, and Tonhauser, 2017). For instance, Stevens et al. (2017) followed Simons et al., 2017 in assuming, first, that utterance content projects if it is entailed by the Question Under Discussion (QUD) addressed by the utterance and, second, that information structural focus constrains the QUD addressed by the utterance. Thus, in a polar question like (2b) *Did Sam shout WILDLY at the dinner party?*, prosodic prominence on the manner adverb *wildly* provides a cue to the manner adverb being in focus, which in turn constrains the (possibly

[2]Even though the prejacent of *again* features a temporal anaphor, it is nevertheless assumed that the prejacent of *again* can be accommodated. For instance, Beck (2006: fn.5) assumed that the prejacent of *again* is accommodated in her example (47a) *In the fall of 1997, they were in Riva. The next fall, they were on the AXALP again*. Naturally occurring examples also show that the prejacent of *again* can be accommodated. Headlines, for instance, can feature *again* without wreaking interpretative havoc: from the headline in (i) we can infer without trouble that The Cure has headlined Glastonbury before. For experimental investigations of the accommodation of the prejacent see Tiemann, 2014; Tiemann et al., 2015 and Bacovcin et al., 2018.

(i) Could The Cure headline Glastonbury again?
`www.radiox.co.uk/artists/cure/robert-smith-talks-cure-headline-glastonbury/`

[3]In addition to the repetitive interpretation, *again* can give rise to a restitutive interpretation. Section 4 briefly considers the observed interaction between focus and the two interpretations of *again* (see, e.g., Beck, 2006).

implicit) QUD to something like 'How did Sam shout at the dinner party?'. This QUD is assumed to denote the set of propositions {Sam shouted x at the dinner party | x is a property of events}. Stevens et al. (2017) also followed Simons et al., 2017 in assuming that a set of propositions P entails a proposition p if and only if every proposition in P entails p. Thus, because {Sam shouted x at the dinner party | x is a property of events} entails the proposition that Sam shouted at the dinner party, a speaker who utters the polar question in (2b) can be taken to be committed to this content, i.e., the prejacent is projective.

As illustrated above, different projection analyses are assumed for the prejacent of *again* and the prejacent of manner adverbs: a lexicalist one for the former and a focus-based one for the latter. This analytic difference is motivated by (at least) two properties on which the two prejacents differ: i) the extent to which they are projective (see Tonhauser, Beaver, and Degen, 2018 for evidence that projectivity is a gradient property of utterance content) and ii) whether their projectivity is sensitive to information structural focus. Regarding the first property, the prejacent of *again* is assumed to be highly projective, whereas the projectivity of the prejacent of manner adverbs is assumed to be weaker. For instance, the prejacent of *again* is typically assumed to be non-suspendable in explicit ignorance contexts (e.g., Simons, 2001; Abrusán, 2016), as shown by the unacceptability of (4a); as a consequence, *again* is typically considered a 'hard trigger' (e.g., Simons, 2001; Abusch, 2010; Abrusán, 2016). In contrast, the prejacent of manner adverbs can be suspended in such contexts, as shown by the acceptability of (4b).

(4) a. [The speaker observes Jane, whose history of video rental she knows nothing about, in a video store.]
#I have no idea whether Jane ever rented "Manhattan", but perhaps she is renting it again. (Simons, 2001: 433)
b. I have no idea whether Sam shouted at the dinner party, but if he shouted WILDLY, he will never be invited again.

This difference in projectivity is taken to be captured by giving different analyses of the prejacent of *again* and of manner adverbs. By analyzing the prejacent of *again* as a lexically triggered presupposition with an anaphoric component (the time t' in (3)), the prejacent of *again* is predicted to be highly projective and not suspendable. By contrast, projective content that is derived from prosodically marked information structural focus, like the prejacent of manner adverbs, is predicted to be more weakly projective, for several reasons: first, prosodic cues to focus are non-deterministic, thereby potentially resulting in uncertainty on part of the listener on which expression is focused and, hence, which QUD the utterance addresses; second, focus constrains the QUD but doesn't determine it, thereby again potentially resulting in uncertainty on part of the listener about the QUD; third, focus-induced projectivity can be overridden by contextual information about the speaker's epistemic state (see also Abrusán, 2011).

A second property on which the prejacents of *again* and manner adverbs are taken to differ is in the sensitivity of their projectivity to information structural focus: the projectivity of the prejacent of manner adverbs is assumed to be sensitive to information structural focus, in contrast to that of the prejacent of *again* (e.g., Beck, 2006; Abrusán, 2013a, b). A focus-based projection analysis for the prejacent of manner adverbs straightforwardly predicts that the projectivity of the prejacent is sensitive to what is focused in the utterance. For instance, if the subject of the polar question in (2b) is focused, as in *Did SAM shout wildly at the dinner* *party?*, then the QUD of the discourse may be the set of propositions {x shouted wildly at the dinner party | x a person}. Because this QUD does not entail that Sam shouted (e.g., the proposition that Sue shouted wildly at the dinner party does not entail that Sam shouted), the prejacent of the manner adverb is not predicted to project. In contrast, the projectivity of a lexically specified presupposition is not expected to be sensitive to information structural focus (for discussion, see Djärv and Bacovcin, 2017 and section 4).

In sum, these differences between the prejacents of *again* and manner adverbs provide empirical motivation for distinct projection analyses. These properties may also help decide between competing analyses of other projective contents. A case in point is the pre-state content of *stop*, for which several different projection analysis have been proposed. This projective content is illustrated in the examples in (5). A speaker who utters the sentence in (5a) is typically taken to be committed to Sam having photographed the Sagrada Familia. Because a speaker who utters the polar question in (5b) may likewise be taken to be committed to Sam having photographed the Sagrada Familia, this content, referred to as the pre-state content, is projective.

(5) a. Sam stopped photographing the Sagrada Familia.
b. Did Sam stop photographing the Sagrada Familia?

The pre-state content of *stop* has traditionally been analyzed as a lexically specified presupposition (e.g., Heim, 1983; van der Sandt, 1992; Kadmon, 2001). More recently, alternative analyses have been proposed. On Abusch's (2002, 2010) and Romoli's (2011, 2015) analyses, for instance, the projectivity of the pre-state content of *stop* is derived from conventionally specified alternatives to *stop* (these analyses differ in their details, as discussed in section 4.) Abrusán (2011, 2016), in turn, proposed that the pre-state content projects because it is by default backgrounded, and Beaver, Roberts, Simons, and Tonhauser (2017) suggested that the pre-state content projects if and only if it is not at-issue with respect to the QUD (see also Simons, Tonhauser, Beaver, and Roberts, 2010; Tonhauser, Beaver, and Degen, 2018).

These analyses differ in their predictions regarding the projectivity of the pre-state content of *stop* and its sensitivity to information structural focus. Regarding projectivity, for instance, the pre-state content is predicted to be more projective if it is lexically specified as a presupposition than if its projectivity is mitigated by the extent to which it is not at-issue, as on Abrusán's (2016) or Beaver et al.'s (2017) analyses. Similarly for information structure sensitivity: on a lexicalist analysis, we may expect the pre-state content to be less sensitive to information structural focus compared to an analysis on which projectivity is derived from information structural properties of the utterance, as in Abrusán (2016) or Beaver et al. (2017).

The experiment reported on in this paper was designed to investigate the projectivity of the prejacent of *again*, the prejacent of manner adverbs and the pre-state content of *stop*, as well as the information structure sensitivity of their projectivity, with the goal of identifying which projection analyses are empirically adequate for these contents. There is already some preliminary experimental evidence in support of a lexicalist analysis of the prejacent of *again* and a focus-based analysis of the prejacent of manner adverbs. First, there is experimental support for the prediction of lexicalist analyses that the prejacent of German *wieder* 'again' is highly projective (we are not aware of an experiment that investigated the projectivity of *again*).[4] Specifically, Xue and Onea (2011) found that the prejacent of *wieder* 'again' is highly projective compared to the prejacent of *auch* 'too' and the contents of the complements of *erfahren* 'find out' and *wissen* 'know'. Their participants read sentences like (6) in which the presupposition trigger occurred in the antecedent of a conditional and were asked whether it is possible that the presupposition is false: e.g., whether it is possible that Thomas hasn't made sushi before.

(6) Wenn Thomas wieder Sushi macht, hilft Maiko dabei.
if Thomas again sushi makes helps Maiko with.it
'If Thomas makes sushi again, Maiko will help him.'
(Xue and Onea, 2011: 176; glosses added)

Participants responded 'no' in 101 (99%) of the 102 trials with *wieder* 'again', suggesting that the prejacent of *wieder* 'again' is highly projective compared to the relevant contents of *auch* 'too' (87% 'no'), *erfahren* 'find out' (52% 'no') and *wissen* 'know' (38% 'no'). This finding supports a lexicalist analysis of the prejacent of *wieder* 'again'.

Second, there is experimental support for the prediction of focus-based analyses that the prejacent of manner adverbs is weakly projective and that its projectivity is sensitive to information structural focus. Stevens, de Marneffe, Speer, and Tonhauser (2017) investigated the projectivity of the prejacent of English manner adverbs, as in (7), in two prosodic conditions: with a L+H* pitch accent on the proper name or on the manner adverb. They assumed that the foci of the utterances were constrained by the position of the pitch accent. Participants assessed whether the speaker is certain of the prejacent; in (7), that Amanda clapped.

(7) Amanda didn't clap loudly.

The mean ratings were 4.8 (out of 7) with a L+H* pitch accent on the proper name and 5.7 with a L+H* pitch accent on the manner adverb. Thus, Stevens et al. (2017) found that the prejacent of manner adverbs was only weakly projective and that its projectivity was sensitive to the prosodic manipulation of information structural focus.

There also is empirical evidence that the pre-state content of *stop* is not highly projective. Tonhauser et al. (2018) investigated the projectivity of projective contents associated with 19 English expressions, including the pre-state content of *stop*. Their Experiment 1a found that the projectivity of the pre-state content of *stop* is not at ceiling, in contrast to, for instance, the content of non-restrictive relative clauses, and significantly less projective than, for instance, the content of the complement of *know*. This finding is more compatible with analyses that assume that *stop* is a 'soft trigger' (e.g., Simons, 2001; Abusch, 2002, 2010; Romoli, 2011, 2015) than with ones that assume that it is a 'hard trigger' (e.g., Kadmon, 2001) or ones that take the pre-state content to be less susceptible to suspension than 'soft triggers' (Abrusán, 2016).

Despite these experimental findings, the currently available empirical evidence is insufficient to evaluate the empirical adequacy of the various analyses of the projective contents of *again*,

[4]The prejacent of *wieder* 'again' and *again* have been experimentally investigated: see, e.g., Schwarz and Tiemann (2012) and Jouravlev et al. (2016) on its processing, Tiemann (2014); Tiemann et al. (2015) and Bacovcin et al. (2018) on whether it is accommodated; and Zehr and Schwarz (2018) on whether it is entailed.

manner adverbs and *stop*. For one, there has not been an experimental investigation of the projectivity of the prejacent of *again*.[5] Furthermore, comparing the findings of the projection experiments reported on in Xue and Onea (2011); Stevens et al. (2017) and Tonhauser et al. (2018) is hampered by the fact that they used different response tasks to assess projectivity. Finally, information structure sensitivity has, to date, only been investigated for the prejacent of manner adverbs (Stevens et al., 2017), but not for the prejacent of *again* or the pre-state content of *stop*. The experiment reported on in this paper aims to contribute to filling these empirical gaps.

2. Methods

The experiment we report on was designed to address the research questions in (8):

(8) Regarding the prejacent of *again*, the prejacent of manner adverbs and the pre-state content of *stop*:
  a. How projective are these contents?
  b. Is the projectivity of these contents sensitive to information structural focus?

Projectivity was assessed using the 'certain that' diagnostic for projection (see also, e.g., Tonhauser, 2016; Djärv and Bacovcin, 2017; Tonhauser et al., 2018; Mahler, 2019): under this diagnostic, participants are presented with utterances, like (9), and asked whether the speaker is certain of some content. For instance, to investigate the prejacent of the manner adverb in (9), participants are asked whether Debby is certain that Alfie texted.

(9) Debby: Did Alfie text secretly?

To compare the projectivity of the three contents, we have to consider their temporal properties: the prejacent of *again* and the pre-state content of *stop* invoke a time that temporally precedes the main clause event time, in contrast to the prejacent of manner adverbs. For instance, the prejacent of *again* in (10a) and the pre-state content of *stop* in (10b) is that Alfie texted before noon. By contrast, the prejacent of the manner adverb in (10c) is that Alfie texted at noon.

(10) a. Did Alfie text again at noon?
  b. Did Alfie stop texting at noon?
  c. Did Alfie text secretly at noon?

To facilitate comparison of the projective contents associated with the three expressions under investigation, the stimuli in our experiment were utterances of polar questions like (11) in which temporal adjunct clauses constrained the relevant times. Crucially, the stimuli realized *when*-clauses with *again* and *stop*, and *before*-clauses with manner adverbs. As a consequence, our experiment investigated the same projective content for the three expressions; in (11), for instance, the projective content for all three expressions is that Alfie texted before Dan arrived.

[5] The experiment reported on in Cummins and Rohde (2015) investigated both the pre-state content of *stop* and the prejacent of *again* with respect to whether prosodically signalled differences in the QUD influence presupposition projection. This work did not compare the 20 presuppositions investigated, but Figure 2 in this work suggests that the pre-state content of *stop* is at least numerically) more projective in the focus condition than in the neutral condition, whereas the opposite is true for the prejacent of *again*.

(11) a. Did Alfie text again when Dan arrived?
b. Did Alfie stop texting when Dan arrived?
c. Did Alfie text secretly before Dan arrived?

The experiment collected gradient certainty ratings for the projective contents associated with *again*, manner adverbs and *stop*. The full set of materials, the code for the analyses and figures, and a link to the experiment are provided in a GitHub repository at https://github.com/judith-tonhauser/projectivity-and-focus-sensitivity.

2.1. Participants

176 participants with U.S. IP addresses and at least 99% of previous HITs approved were recruited on Amazon's Mechanical Turk platform (ages: 20-76; mean age: 36; 85 women, 91 men). They were paid $1.20 for participating in the experiment.

2.2. Materials

The target stimuli were 432 utterances of 108 polar questions consisting of a main clause and an adjunct clause, like those in (11). As discussed above, the adjunct clauses for polar questions with *again* and *stop* were introduced by *when*, and the adjunct clauses for polar questions with manner adverbs were introduced by *before*. The polar questions featured 12 verbs, namely *text*, shown in (11), as well as *clean, shout, yell, bark, knock, whistle, speak, walk, smile, cry* and *giggle*. We combined each of these verbs with 3 proper name subjects and adjunct clauses, for a total of 36 triples of polar questions like (11), i.e., a total of 108 polar questions. The full set of polar questions is provided in Appendix A of the GitHub repository.

The adjunct clauses that each main clause verb was combined with were minimal variants of one another, e.g., the variants of *Dan arrived* in (11) in the other 2 triples with *text* were *Kim showed up* and *Tom walked in*. In the manner adverb polar questions, the verb of the main clause was combined with a unique manner adverb: *text*, for instance, only occurred with *secretly*. The manner adverbs were chosen so that it is possible for the event described by the verb to be carried out in the manner described by the adverb, as well as not in that manner: for instance, it is possible to text secretly, and it is possible to text not secretly. This was done because Stevens et al. (2017) found that the projectivity of the prejacent of negated sentences with *smile cheerfully* (e.g., that Sandy smiled, in *Sandy didn't smile cheerfully*) was comparatively lower; we hypothesized that this was due to it being difficult for somebody who doesn't smile cheerfully to smile at all.

The position of information structural focus was manipulated prosodically: we recorded each of the 108 polar questions in four conditions, as illustrated in (12): a low pitch accent (L* in ToBI, the Tones and Break Indices annotation system, Beckman and Ayers, 1997) was realized on the auxiliary, as in (12a), the proper name subject, as in (12b), the verb, as in (12c), or the target expression, *again*, as in (12d); in target stimuli with *stop* or a manner adverb, the low pitch accent was realized on *stop* or the manner adverb in the target condition. The L* pitch accent was the only one realized in the utterance.[6] The pitch contour after the L* pitch accent was high and relatively flat, and ended with an increase in f0, i.e., a H-H% boundary tone.

(12) Four focus conditions, illustrated for the polar question in (11a)[7]

a. Did Alfie text again when Dan arrived? [auxiliary focus]
   L* H-H%

b. Did Alfie text again when Dan arrived? [subject focus]
   L* H-H%

c. Did Alfie text again when Dan arrived? [verb focus]
   L* H-H%

d. Did Alfie text again when Dan arrived? [target focus]
   L* H-H%

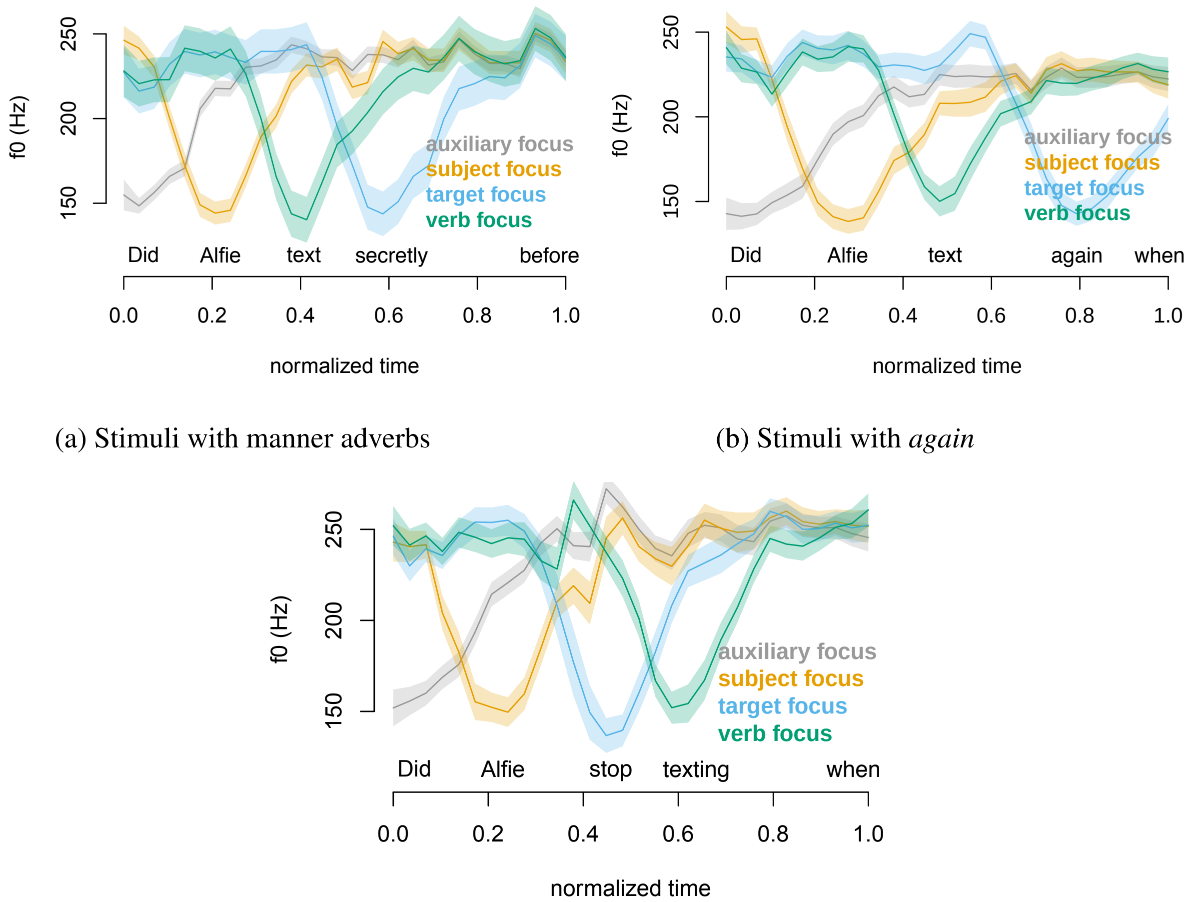
To reduce the prosodic variation between the 4 utterances of each of the 108 polar questions, we selected one recording of the temporal adjunct clause (e.g., *Dan arrived* in (11)), and spliced it with the recordings of the 4 main clauses; for details on the recording and splicing procedure, as well as two norming studies we conducted see Appendix B in the GitHub repository. The full set of stimuli is also provided in the GitHub repository.

To illustrate the prosodic manipulation of interest, we extracted, in 10ms intervals, the f0 values of the main clauses and the temporal adjunct marker (*when* for stimuli with *again* and *stop*, *before* for stimuli with manner adverbs). We then fitted generalized additive mixed effects models to these f0 values (a separate model for each target expression): these models predict the f0 values from focus condition smoothed over normalized time, with random effects for adjunct clause content, using the `mgcv` package (version 1.8-23; Wood, 2011, 2017) in R (version 3.5.0). Figure 1 plots these fitted f0 values for the stimuli for each target expression by focus condition using the `itsadug` package (version 2.3.0; van Rij et al., 2017). Shaded bands indicate pointwise 95% confidence intervals. As shown, the L* pitch accents are characterized by a localized drop in f0 and the locations of the L* pitch accent are clearly distinguished across the four focus conditions. The relatively thin confidence interval bands suggest that there is relatively little variation between the utterances in each focus condition (but future research will need to consider how the variation contributes to listeners' interpretation of projection).

The 432 utterances were divided into 12 lists of 36 target stimuli so that each list realized each of the 12 main clause verbs with each of its 3 adjunct clauses (i.e., a total of 36 distinct combinations of main clause verbs and adjunct clauses). Both the factor 'target expression' (with 3 levels: *again, stop*, manner adverb) and the factor 'focus condition' (with 4 levels: auxiliary, subject, verb, target) were fully crossed on each list according to a latin square design. In addition to the 36 target stimuli, each list realized 4 control stimuli, which were productions of the 4 polar questions with *after*-clauses in (13). These control stimuli were included to assess whether participants were attending to the task and interpreted the task correctly. We expected

[6] We used a L* rather than a H* pitch accent to mark focus because the former has been described as less biasing in polar questions than the latter (e.g., Pierrehumbert and Hirschberg, 1990: 290ff.).

[7] While we describe the tune realized on our target stimuli as L* H-H% here, it is also possible to describe it as L*+H H-H%, i.e., with a L*+H pitch accent on the stressed syllable of the focus rather than a L* pitch accent.



(a) Stimuli with manner adverbs

(b) Stimuli with *again*

(c) Stimuli with *stop*

Figure 1: Non-linear smooths of the fitted f0 values for the main clauses and temporal adjunct markers of the target stimuli, by focus condition. Shaded bands indicate pointwise 95% confidence intervals.

their main clause contents to be not projective: for instance, we expected the content that Sue came over to not project from (13a).

(13) a. Did Sue come over after Paul left?
b. Did Gina send an email after the meeting ended?
c. Did Frank go to Cancun after he graduated?
d. Did Mark watch TV after he got home?

The 40 stimuli were realized on each list in a pseudo-randomized order.

2.3. Procedure

Participants were randomly assigned to a list and told to imagine that they are at a party and that, upon walking into the kitchen, they overhear Debby, the party host, ask another guest a question. They were presented with the 40 stimuli, one after the other. On each trial, participants listened to the stimulus as often as they wanted and then responded to the ‘certain that’ question on a 5-point Likert scale labeled ‘No, Debby is not certain’ (coded as 1) at one end and ‘Yes, Debby is certain’ (coded as 5) at the other end, as shown in Figure 2.

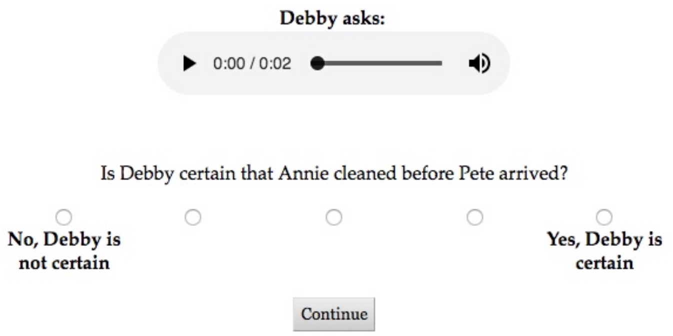


Figure 2: A sample trial

Participants then filled out a brief questionnaire about their age, their gender, their native language(s) and, if English is a native language, whether it is American English, as opposed to, e.g., Indian or Australian English. They were told that they would be paid no matter how they responded to these questions, to encourage them to answer truthfully.

2.4. Data exclusion

Prior to analysis, we excluded the data of 5 participants who did not self-identify as native speakers of American English. Of the remaining 171 participants, 6 selected ‘No, Debby is not certain’ in all 40 trials; we also excluded their data under the assumption that they did not attend to the task or interpreted the task differently. The remaining 165 participants gave low responses to the 4 control stimuli: as shown in the left panel of Figure 3, most responses were 1 or 2 (the group mean response was 1.7). For 126 of the 165 participants, the mean response to the 4 control stimuli was at or below 2, as shown in the right panel of Figure 3.

The results presented in the next section are based on the data from the 126 participants for whom the content of the controls on average was not projective (ages 21-76; mean age: 36; 62 women, 64 men).[8] The group mean response to the 4 controls by these participants was 1.2.

3. Results

We start by addressing the question of how projective the three contents are. The box plot in Figure 4 shows the certainty ratings for the contents by expression, collapsing over focus conditions and lexical contents, as well as the certainty ratings for the control stimuli. The mean certainty ratings are given by larger black dots, the notches indicate medians and the smaller

[8]There are no substantial changes to the findings we report on in the next section if the data from the 39 participants with higher mean certainty ratings on the control stimuli are included in the analyses; see footnote 10.

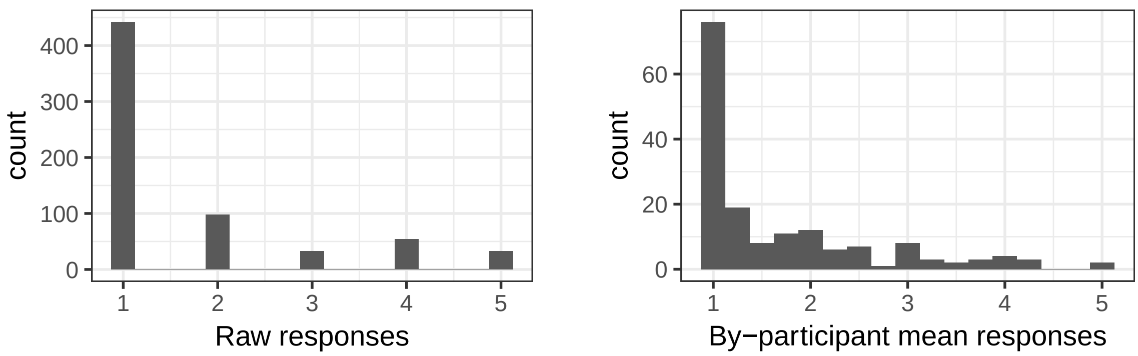


Figure 3: Histogram of 165 participants' raw responses (left panel) and mean responses (right panel) to the 4 control stimuli.

black dots indicate outliers. The raw ratings are given by jittered transparent dots: each of the 432 target polar questions received between 5 and 16 certainty ratings (mean: 10.5); there are 1,512 ratings for each projective content and 504 for the contents of the controls. As expected, the mean certainty rating for target stimuli with manner adverbs was low (1.8), suggesting weak projectivity of the prejacent of manner adverbs; the median certainty rating was 1. For target stimuli with *again*, neither the mean certainty rating (3.7) nor the median certainty rating (4) were at ceiling, contrary to the predictions of lexicalist analyses of the prejacent of *again*. The mean certainty rating for the pre-state content of *stop* (3.8) was numerically the highest of the three projective contents investigated; here, the median certainty rating (5) was at ceiling.

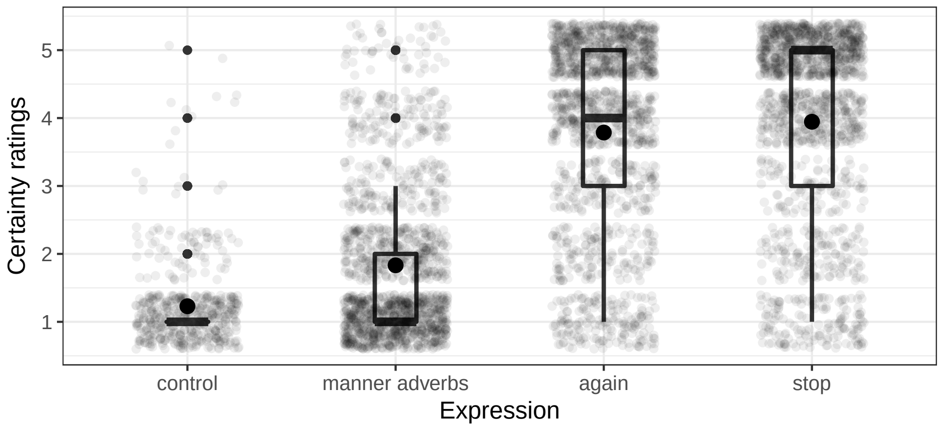


Figure 4: Box plot of certainty ratings by expression, collapsing over focus conditions and lexical contents, as well as of the controls. Larger black dots indicate means, notches indicate medians and smaller black dots indicate outliers. Raw certainty ratings are represented by jittered transparent dots.

To compare the projectivity of the three contents to each other and to the non-projecting controls, we fitted an ordinal mixed effects model predicting the certainty ratings from a fixed effect of expression (with 'control' as the reference level and treatment coding), using the `ordinal` package (version 2018.4-19, Christensen, 2013) in R (version 3.5.0, R Core Team, 2016; 5,040 data points). The model included the maximal random effects structure justified by the data and the theoretical assumptions that allowed the model to converge: random by-verb intercepts (capturing differences in projectivity between verbs), random by-lexical content intercepts (capturing differences in projectivity between the lexical contents of the subjects and adjunct clauses), random by-item intercepts (capturing differences in projectivity between items), random by-participant intercepts (capturing differences in projectivity between participants) and random slopes for expression by participant (capturing that the effect of expression may vary across participants). We then conducted a pairwise comparison with the `lsmeans` package (Hothorn et al., 2008, version 2.27-62) using Tukey's correction for multiple comparisons.

Compared to the ratings for the non-projective content of the controls, the ratings were significantly higher for the prejacent of manner adverbs (β = 1.82, *SE* = 0.4, z = 4.58, $p < .0001$), for the prejacent of *again* (β = 5.89, *SE* = 0.48, z = 12.23, $p < .0001$) and for the pre-state content of *stop* (β = 6.38, *SE* = 0.49, z = 12.93, $p < .0001$). These findings confirm that the three contents under investigation are projective. Furthermore, certainty ratings for the prejacent of *again* were lower than those for the pre-state content of *stop* (β = -.49, *SE* = 0.14, z = -3.45, $p = .0032$), and ratings for the prejacent of manner adverbs were lower than those for the prejacent of *again* (β = -4.07, *SE* = 0.31, z = -13.06, $p < .0001$) and for the pre-state content of *stop* (β = -4.56 *SE* = 0.34, z = -13.45, $p < .0001$). In sum, the prejacent of manner adverbs is projective, albeit only weakly so compared to the prejacent of *again* and the pre-state content of *stop*. Furthermore, the projectivity of the prejacent of *again* was lower than that of the pre-state content of *stop* and, contrary to expectation, not at ceiling.

We next address the question of whether projectivity is sensitive to information structural focus by assessing whether certainty ratings are sensitive to the prosodic manipulation. The box plot in Figure 5 shows the certainty ratings for the projective contents by expression and focus condition, collapsing over lexical contents. As above, the mean certainty ratings are given by larger black dots, the notches indicate medians and the smaller black dots indicate outliers. The raw certainty ratings are given by jittered transparent dots: there are 378 ratings per projective content in each of the four focus conditions. As expected, both the mean and the median certainty ratings for the prejacent of manner adverbs are higher in the target condition (where the L* pitch accent was realized on the manner adverb) than in the other three focus conditions. The same pattern is observed for the prejacent of *again*: both the mean and the median certainty ratings are higher in the target condition (L* pitch accent on *again*) than in the other three focus conditions. For the pre-state content of *stop*, the mean certainty rating is also highest in the target condition (L* pitch accent on *stop*); here, the median certainty rating is higher in the target and verb conditions than in the auxiliary and subject conditions.

To assess the influence of focus condition on the certainty ratings, we fitted ordinal mixed effects models predicting the ratings from focus condition (with 'target' as the reference level and treatment coding); we built a separate model for each content (1,512 data points each). The three models included the same random effects structure as the aforementioned model. We then conducted pairwise comparisons of the focus conditions using the `lsmeans` package, as above.

For the prejacent of manner adverbs, the certainty ratings in the target condition were significantly higher than those in the auxiliary condition (β = .87, *SE* = 0.23, z = 3.75, $p = .001$), the subject condition (β = .71, *SE* = 0.19, z = 3.68, $p = .0013$) and the verb condition (β = .68,

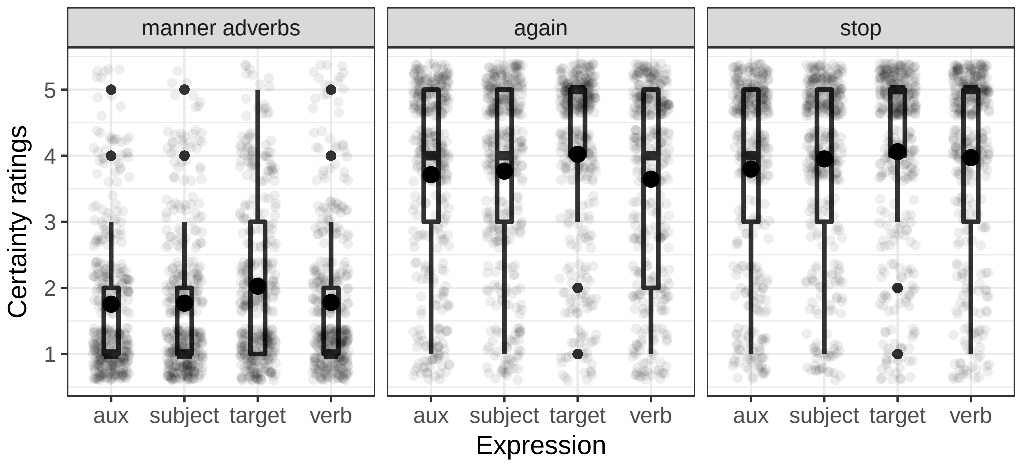


Figure 5: Box plot of certainty ratings by target expression and focus condition, collapsing over lexical contents. Larger black dots indicate means, notches indicate medians and smaller black dots indicate outliers. Raw certainty ratings are represented by jittered transparent dots.

SE = 0.18, z = 3.69, $p = .0013$).[9] Likewise for the prejacent of *again*: the certainty ratings in the target condition were significantly higher than those in the auxiliary condition (β = .74, *SE* = 0.19, z = -4, $p = .0004$), the subject condition (β = .52, *SE* = 0.19, z = 2.72, $p = .03$) and the verb condition (β = .78, *SE* = 0.19, z = 4.13, $p = .0002$). For the pre-state content of *stop*, the certainty ratings in the target condition were significantly higher than those in the auxiliary condition (β = .7, *SE* = 0.19, z = 3.6, $p = .0017$) and marginally higher than those in the subject condition (β = .46, *SE* = 0.19, z = 2.37, $p = .08$); the certainty ratings in the auxiliary condition were marginally lower than those in the verb condition (β = -.5, *SE* = 0.2, z = -2.49, $p = .06$).[10] No other pairwise comparisons were significant.

These findings suggest that the projectivity of the three projective contents investigated is sensitive to prosodically marked information structural focus. The three contents differed, however, in how the prosodic manipulation affected the certainty ratings. For manner adverbs and *again*, the prejacent was more projective when the L* pitch accent was realized on the manner adverb or on *again*, respectively, than when the L* pitch accent was realized on the auxiliary, the subject or the verb. For *stop*, the pre-state content was more projective when the L* pitch accent was realized on *stop* than when it was realized on the auxiliary.

4. Discussion

The experiment reported on in this paper was designed to investigate the projectivity of the prejacent of manner adverbs, the prejacent of *again* and the pre-state content of *stop*, as well as whether their projectivity is sensitive to prosodically marked information structural focus. In

[9] A model that was identical except that it included the non-projective contents of the controls showed that the prejacent of manner adverbs received significantly higher certainty ratings than the content of the controls in each of the focus conditions. This finding suggests that the prejacent is projective in each of the focus conditions.

[10] A model that was fit on the data that included the data from the 39 participants with higher mean certainty ratings on the control stimuli showed that the certainty ratings in the auxiliary condition for *stop* were significantly lower than those in the verb condition (β = -.41, *SE* = 0.15, z = -2.72, $p < .05$).

this section, we discuss whether current analyses account for our findings (sections 4.1 to 4.3) and also discuss implications for empirically adequate projection analyses (section 4.4).

4.1. Prejacent of manner adverbs

As discussed in section 1, the projectivity of the prejacent of manner adverbs is generally attributed to information structural focus (e.g., Abrusán, 2013a; Stevens et al., 2017); specifically, these analyses predict that if the manner adverb is in focus, the prejacent is projective. This prediction is supported by our experiment findings: the prejacent of manner adverbs was projective when the L* pitch accent was realized on the manner adverb, i.e., when the prosodic realization of the polar question provided a cue to the manner adverb being in focus. A second finding that projection analyses need to account for is that the prejacent was only weakly projective. As discussed in section 1, Stevens et al. (2017) assumed that the prejacent projects if it is entailed by the QUD addressed by the utterance, with the QUD constrained by information structural focus, among other things. Taken together with the assumption that prosody provides a cue to, but does not determine, information structural focus (see, e.g., Breen et al., 2010; Tonhauser, 2019), we hypothesize that the prejacent of manner adverbs was only weakly projective when the L* pitch accent was realized on the manner adverb because listeners may have uncertainty about i) whether the manner adverb was in focus, and ii) whether the speaker's utterance was relevant to a QUD that entailed the prejacent.

This hypothesis leads us to expect higher certainty ratings when there is less uncertainty about what is focused or about the QUD. An interesting test case is a language like Hungarian in which what is focused is syntactically constrained (e.g., Szabolcsi, 1981; Kiss, 1987). As discussed in Abrusán (2013a), the preverbal expression is focused in Hungarian when the aspectual particle of the verb appears after the verb. Thus, the manner adverb *hangosan* 'loudly' is not focused in (14a), but it is focused in (14b), where the particle *el* appears after the verb.

(14) Hungarian, adapted from Abrusán, 2013a: 260

a. Kétlem, hogy Péter hangosan elénekelte a Himnuszt
doubt.1sg that Peter loudly prt.sang the anthem.acc
'I doubt that Peter sang the anthem loudly.'

b. Kétlem, hogy Péter hangosan énekelte el a Himnuszt
doubt.1sg that Peter loudly sang prt the anthem.acc
'I doubt that Peter sang the anthem loudly.'

According to Abrusán (2013a: 260), the prejacent, that Peter sang the anthem, projects in (14b) but not in (14a). Whether the prejacent of manner adverbs is more projective when what is focused is syntactically marked (as in the Hungarian examples above) than when it is only prosodically cued (as in our English stimuli) is an open question for future research.

A third finding that projection analyses need to account for is that the prejacent was weakly projective even when the L* pitch accent was realized on an expression other than the manner adverb. This finding is incompatible with the assumption made in, for instance, Simons (2001) and Abrusán (2013a), that the prejacent is not projective when an expression other than the manner adverb is in focus. This assumption is not made in Stevens et al. (2017): here, the prejacent is predicted to project if it is entailed by the QUD (note the *if*!), which leaves open the possibility of other factors contributing to the projectivity of the prejacent.

One possibility is that the projectivity of the prejacent, i.e., the inference that the speaker is committed to the truth of the prejacent, is a conversational implicature. To illustrate, consider the pair of polar questions in (15).

(15) a. Was Sandy smiling?
b. Was Sandy smiling ironically?

The polar question in (15a) is appropriate when the issue of whether Sandy was smiling is open, i.e., the speaker's epistemic state is compatible with Sandy having smiled and with Sandy not having smiled. In fact, this is an open issue even if one of the three expressions in (15a) is focused. Now consider an utterance of the variant with the manner adverb in (15b). Given that the speaker could have uttered the simpler polar question in (15a), listeners will assume that a speaker who utters (15b) is not merely interested in resolving the issue of whether Sandy was smiling. Rather, listeners may assume that such a speaker is interested in resolving a more specific issue. With focus on the auxiliary or the manner adverb, that more specific issue appears to be whether the manner in which Sandy was smiling was ironic, which implies that the speaker already assumed that Sandy was smiling. With focus on the subject proper name, the more specific issue appears to be who the individuals are who were smiling ironically. Given that only individuals who were smiling are relevant and given that Sandy was mentioned as a possible alternative, listeners may take the speaker to be committed to Sandy having smiled. Finally, with focus on the participle *smiling*, the more specific issue appears to be which activity Sandy was engaged in in an ironic manner. Again, the listener may assume that the speaker is only considering activities that Sandy is already engaged in and therefore that Sandy was smiling. In short, the prejacent of (15b) may be projective as a result of listeners' reasoning about speakers' epistemic states and alternative polar questions that speakers could have uttered.

In sum, our experiment found that the prejacent of manner adverbs is weakly projective regardless of focus condition and that it is more projective when the manner adverb is focused. These findings are accounted for by Stevens et al.'s (2017) focus-based analysis in combination with domain-general reasoning about speakers' utterances.

4.2. Prejacent of *again*

As discussed in section 1, the projectivity of the prejacent of *again* is generally accounted for by specifying it as a presupposition in the lexical entry of *again* (e.g., Kamp and Rossdeutscher, 1994; Fabricius-Hansen, 2001; Simons, 2001; Jäger and Blutner, 2003; van der Sandt and Huitink, 2003; Beck, 2006; but see Abrusán, 2013b, 2016). As a lexically specified presupposition, we expect the prejacent to be highly projective, even more so because *again* is typically considered a 'hard' trigger. However, contrary expectation, the mean certainty rating for the prejacent of *again* was only 3.7 (out of 5) and the median certainty rating (4) was also not at ceiling.[11]

[11] Our assumption that the observed certainty ratings for the prejacent of *again* are lower than ceiling is also justified by the finding that the certainty ratings for the pre-state content of *stop* were significantly higher.

This finding differs from that of Xue and Onea (2011) for German *wieder* 'again'. There are, however, several important differences between the two experiments, including the entailment-canceling environment (antecedent of conditional in Xue and Onea, 2011 vs. polar question in ours), the response task (possibility of prejacent being false vs. certainty ratings), the response options offered to the participants ('yes, it's possible'/'no, it's not possible'/'I don't know' vs. 5-point Likert scale), the other projective contents explored, the presentation of the stimuli (in writing vs. auditorily), the number of participants (34 vs. 126), the number of items judged by each participant (3 vs. 12), as well as whether prosody was manipulated. Future research will need to establish whether (a combination of) any of these differences contributed to the different finding or whether there is cross-linguistic variation.

Do currently available projection analyses predict our findings for the prejacent of *again*? We first consider analyses of the prejacent as a lexically specified presupposition. Such analyses generally rely on the process of local accommodation to account for non-projecting presuppositions: local accommodation is typically assumed for presuppositions that need to be accommodated (i.e., that are not in the common ground of the interlocutors when the sentence with the triggering expression is uttered) and for which the default global accommodation would lead to contradiction with information already in the common ground, uninformativity or problems with binding (e.g., Heim, 1983; van der Sandt, 1992). In our experiment, default global accommodation cannot be assumed to be overridden by information contributed by prior utterances. However, as discussed in Djärv and Bacovcin, 2017 for utterances of sentences with factive predicates like *discover*, the prosodic realization of the utterance may contribute an inference that contradicts the presupposition, thereby resulting in local accommodation. To illustrate Djärv and Bacovcin's (2017) proposal, consider an utterance of the sentence with the factive predicate *discover* in (16) in which the subject of the clausal complement, *Anna*, is focused, as indicated by the brackets with the subscripted 'F'.

(16) John might have discovered that [Anna]$_F$ left town. (Djärv and Bacovcin, 2017: 129)

Under a lexicalist analysis, the content of the complement of *discover* is lexically specified as a presupposition. As a consequence, if the content of the complement in (16), that Anna left town, is not part of the common ground at the time at which (16) is uttered, it must be accommodated, with global accommodation being the default. Djärv and Bacovcin (2017) suggested that focus on *Anna* implies that the QUD addressed by (16) is something like 'Who left town?', which implies that the speaker does not know whether Anna left town. Djärv and Bacovcin (2017) proposed that there is an interaction between the lexically specified presupposition and the inference from focus: listeners are less likely to globally accommodate the presupposed content of the complement because doing so would contradict the inference contributed by focus.

This kind of account does not, however, seem to be able to predict local accommodation of the presupposed prejacent of *again*. Consider the sentence in (1b), repeated below for convenience, in which *again*, according to a lexicalist analysis, triggers the presupposition that Sam visited Barcelona before July 2018. In order for the QUD addressed by (1b) to override the default global accommodation of this presupposition, the QUD would need to imply that the speaker does not know whether Sam visited Barcelona before early July 2018.

(1b) Did Sam visit Barcelona again in early July 2018?

It does not appear to be the case that focus on any of the expressions in this polar question yields such a QUD. Consider, for instance, focus on *Sam*: (1b) may then be taken to be part of a discourse in which the QUD is something like 'Who visited Barcelona in early July 2018?'.[12] This QUD implies uncertainty on part of the speaker about who visited Barcelona in early July 2018, but not about whether Sam visited Barcelona before July 2018. What if *again* is focused in (1b)? Beck (2006: §5) assumed that the alternatives to *again* are an empty adverb and *still*. Thus, if *again* is focused in (1b), the QUD addressed by (1b) is something like the set {Sam visited Barcelona again in early July 2018, Sam visited Barcelona in early July 2018, Sam is still visiting Barcelona in early July 2018}. This semantic question implies that the speaker knows that Sam visited Barcelona in early July 2018, but not whether Sam's visit in Barcelona began at a time before July 2018 and has continued to early July 2018, or whether Sam went elsewhere in the mean time. Crucially, however, because this QUD does not imply that the speaker does not know whether Sam visited Barcelona before early July 2018, focus on *again* does not override the default global accommodation of the presupposed prejacent.

On Abrusán's (2013b; 2016) account, the prejacent of *again* is projective not because it is a lexically specified presupposition but because it is an entailment that is by default backgrounded. Although Abrusán's account allows for the possibility of entailments that are by default backgrounded to be foregrounded and therefore not projective (for instance when the QUD is about the entailed content), Abrusán also assumed that the prejacent of *again* (as well as that of other additive particles) cannot be suspended (Abrusán, 2016: e.g., 167, 168, §2.2). Consequently, her account is designed to predict that the prejacent of *again* cannot be suspended, regardless of which expression is focused, and it therefore does not account for our experiment findings. In sum, current analyses of the prejacent of *again* do not account for the lower-than-ceiling certainty ratings observed for *again* in our experiment.

Our finding that the projectivity of the prejacent of *again* is not at ceiling resonates with the observation, reported in Abrusán (2016: fn.3), that suspension examples like (4a), repeated below, may not be judged to be as unacceptable as parallel examples with other supposedly 'hard' presupposition triggers, like *too*.

(4a) [The speaker observes Jane, whose history of video rental she knows nothing about, in a video store.]
#I have no idea whether Jane ever rented "Manhattan", but perhaps she is renting it again.
(Simons, 2001: 433)

This kind of observation, together with our experiment findings, suggest that it is not empirically adequate to classify *again* as a 'hard' presupposition trigger.

Recall that our experiment also found that the projectivity of the prejacent of *again* was sensitive to the prosodic manipulation of information structural focus: the prejacent was more projective when the L* pitch accent was realized on *again* than when the L* pitch accent was realized on another expression in the main clause. Neither the lexicalist analysis nor Abrusán's entailment-based analysis of the projectivity of the prejacent accounts for the observed sensitivity to information structural focus (under the assumption that the expression that realizes the

[12]Following Beck, 2006: fn.4, we assume that *again* contributes only presupposed material and that, therefore, its contribution is not part of the focus-induced alternatives.

L* pitch accent is in focus). The lexicalist analysis does not because, as discussed above, focus on any of the expressions in the main clause does not lead to QUDs that would override the default global accommodation. And on Abrusán's account, too, the projectivity of the prejacent of *again* is, by design, independent of information structural focus.

Before concluding this section, we consider a different avenue for accounting for the sensitivity of the projectivity of the prejacent of *again* to the prosodic manipulation. This consideration is based on the long-standing observation that *again* is compatible not only with the repetitive interpretation entertained thus far, but also with a so-called restitutive interpretation. Crucially, focus on *again* decreases the availability of the restitutive interpretation. To illustrate, consider the examples in (17). The example in (17a), with focus on *opened*, can receive both a repetitive interpretation (Otto had opened the door before, and now he opened it again) and a restitutive interpretation (somebody had closed the door, and Otto has caused it to be open again). By contrast, (17b), with focus on *again*, is biased towards a repetitive interpretation.

(17) Beck (2006: 280)
  a. Otto OPENED the door again.
  b. Otto opened the door AGAIN.

Restitutive *again* does not give rise to the inference under consideration in this paper: under a restitutive interpretation, (17a) does not imply that Otto opened the door before. Is it possible that our experiment found higher certainty ratings for stimuli in which the L* pitch accent was realized on *again* because these stimuli favor a repetitive interpretation? We argue that this is not a possible explanation for our findings. The restitutive interpretation is only available for predicates that describe an event with a result state: with such predicates, *again* can contribute the information that the result state was restored. As discussed in section 2, the predicates in our stimuli were *text, clean, shout, yell, bark, knock, whistle, speak, walk, smile, cry* and *giggle* in their intransitive frames. Except for *clean*, none of these predicates have telic uses (e.g., *Sam whistled for/*in 2 hours*, but *Sam cleaned for/in 2 hours*), which means that they are incompatible with a restitutive interpretation. However, even though the restitutive interpretation is possible for *clean*, the effect of focus condition on the projectivity of the prejacent of *again* was not limited to stimuli with *clean* (recall that the model we fit to the data in section 3 included a by-verb intercept). Thus, the lower-than-ceiling projectivity of the prejacent of *again* cannot be attributed to the restitutive interpretation of *again*.

In sum, currently available analyses of the prejacent of *again* predict that its projectivity is at ceiling and insensitive to information structural focus. Our experiment findings suggest that both of these predictions are empirically inadequate.

4.3. Pre-state content of *stop*

As mentioned in section 1, the pre-state content of *stop* has traditionally been analyzed as a lexically specified presupposition, like the prejacent of *again* (e.g., Heim, 1983; van der Sandt, 1992; Kadmon, 2001). Can this type of analysis account for the findings of our experiment? Recall from section 4.2 that lexicalist analyses rely on local accommodation to account for non-projecting presuppositions and that the default global accommodation cannot be assumed to be overridden in our experiment by information contributed by prior utterances. Focus-induced inferences about the QUD, however, may conflict with the lexically specified presupposition of *stop*, thereby predicting local accommodation. To illustrate, consider the sentence in (18), in which *stop*, according to a lexicalist analysis, triggers the presupposition that Sam smoked before he turned 18. In order for the QUD addressed by (18) to override the default global accommodation of this presupposition, the QUD would need to imply that the speaker does not know whether Sam smoked before he turned 18.

(18) Did Sam stop smoking when he turned 18?

Consider an utterance of (18) with focus on *Sam*, which may be taken to be part of a discourse in which the QUD is something like ‘Who stopped smoking when they turned 18?’. It is possible for such an utterance of (18) to be part of a discourse in which the contextually salient alternatives to *Sam* are individuals who used to smoke. In this case there is no uncertainty on part of the interlocutors about whether Sam smoked before he turned 18, i.e., no local accommodation is expected. But it may also be possible for an utterance of (18) with focus on *Sam* to be part of a discourse in which the contextually salient alternatives to *Sam* include individuals who used to smoke as well as individuals who have never smoked. If so, the listener may take the speaker of (18) to be uncertain about whether Sam smoked before he turned 18. This focus-induced inference about the QUD may then override the default global accommodation of the lexically specified presupposition of *stop*, predicting non-projection.

What about the second finding of our experiment, that the pre-state content is more projective with focus on *stop* than with focus on the auxiliary? Whether this finding can be accounted for under a lexicalist analysis depends on i) which alternatives to *stop* are considered and ii) and the details of the analysis of focus on the auxiliary, also known as verum focus (e.g., Höhle, 1992). With respect to i), under a standard focus semantics (e.g., Rooth, 1992), the alternatives to *stop* are expressions of the same type as *stop*, such as *continue* or *start*. Of course, (18) with focus on *stop* may be part of a discourse in which only individuals who smoked before they turned 18 are under consideration. In this case, the alternatives to *stop* may be restricted to, for instance *continue* and *used to*, resulting in a QUD that does not convey uncertainty on part of the speaker about whether Sam smoked before he turned 18. In this case, the presupposition is not predicted to be locally accommodated. But (18) with focus on *stop* may also be part of a discourse in which the speaker doesn’t know whether Sam smoked before he turned 18. Here the alternatives to *stop* might include *continue* and *start*, in which case the QUD is something like ‘Has Sam smoked in the past or, if he has, does he still smoke?’. This focus-induced QUD may lead the listener to infer that the speaker is not certain about whether Sam smoked before he turned 18, predicting non-projection. Thus, without further restrictions on the alternatives to *stop*, focus on *stop* may result in the inference that the speaker is not certain about the presupposed pre-state, resulting in non-projection of the presupposition.

With respect to ii), we consider the analyses of verum focus proposed in Romero and Han (2004) and Gutzmann and Castroviejo Miró (2011). Under Romero and Han’s (2004) proposal, (18) with focus on the auxiliary would denote the question $\{p$: the speaker is sure that Sam stopped smoking when he turned 18, $\neg p$: the speaker is not sure that Sam stopped smoking when he turned 18$\}$. Because the proposition $\neg p$ can include worlds in which Sam never smoked, a speaker who utters (18) with focus on the auxiliary may be taken to be uncertain about whether Sam smoked before he turned 18, resulting in non-projection of the presupposed pre-state content. Under Gutzmann and Castroviejo Miró's (2011) proposal, the positive polar question in (18) with focus on the auxiliary denotes the usual set of alternatives, i.e., $\{p$: Sam stopped smoking when he turned 18, $\neg p$: Sam didn't stop smoking when he turned 18$\}$. Verum focus contributes the use-conditional meaning that the speaker wants to downdate the question: this means that the speaker conveys that (they assume that) the listener is sure that their answer should be added to the common ground (p.162). Crucially, however, the speaker is not sure about p (otherwise they wouldn't have asked the question), which means that a speaker who utters (18) with focus on the auxiliary may be taken to convey uncertainty about whether Sam smoked before he turned 18, resulting in non-projection of the presupposed pre-state content. In sum, a lexicalist analysis of the pre-state content of *stop*, augmented with assumptions about focus alternatives to *stop* and an analysis of verum focus, predicts the possibility of non-projection of this content both if *stop* is focused and if the auxiliary is focused. It is therefore not clear that such an analysis accounts for the second finding of our experiment, that the pre-state content is more projective with focus on *stop* than with focus on the auxiliary.

Non-lexicalist analyses of the pre-state content of *stop* (e.g., Abusch, 2002, 2010; Abrusán, 2011, 2016; Romoli, 2011, 2015; Beaver et al., 2017) were driven by two observations. The first one is that this content can be suspended in explicit ignorance contexts, as in (19). This means that *stop* is not a 'hard' presupposition trigger (but see Abrusán, 2016). In line with this observation, Tonhauser et al. (2018) found that the projectivity of the pre-state content of *stop* is not at ceiling.

(19) I have no idea whether Jane ever smoked, but she hasn't stopped smoking.
(Simons, 2001: 433)

The second observation is that the pre-state content of *stop* does not appear to be associated with the expression but rather with its content; in other words, the pre-state content of *stop* is nondetachable (Grice, 1975). Evidence comes from Simons's (2001) observation that English variants of (20a) with *quit, cease* and *discontinue* give rise to the same content and Tonhauser et al.'s (2013) finding that the same is true of the Paraguayan Guaraní variant of (20a) in (21): here, the change-of-state meaning is not coded by a lexical item but by the combination of the negation circumfix, the suffix *–ve* 'more' and perfect aspect *–ma* (see also Levinson and Annamalai, 1992):[13]

(20) Simons (2001: 435)
a. Jane didn't stop laughing.
b. Jane didn't quit laughing.
c. Jane didn't cease laughing.
d. Jane did not discontinue her laughter.

(21) Jáne nd-o-puka-vé-i-ma.
Jane NEG-A3-laugh-more-NEG-PRF
'Jane stopped laughing.'

[13]The glosses in the Paraguayan Guaraní examples follow the Leipzig Glossing Conventions, except for 'A3', which is a third person marker from the set A series (Tonhauser, 2017).

Do non-lexicalist analyses of the pre-state content of *stop* predict the findings of our experiment? On Abusch's (2002, 2010) analysis, the projectivity of this content is derived from the assumption that the conventionally specified alternative to *stop* is *continue* and the assumption that propositions that are entailed by each alternative in the set of alternatives are projective, unless there is contextual evidence to the contrary. For (18), the set of alternatives is {Sam stopped smoking when he turned 18, Sam continued smoking when he turned 18}. Because each alternative in this set entails that Sam smoked before he turned 18, the pre-state content is predicted to be projective. To assess whether Abusch's (2002, 2010) analysis accounts for the findings of our experiment, let's assume that focus-induced inferences about the QUD can provide evidence that the speaker is not committed to the pre-state content, and thereby provide contextual evidence about non-projection. Because alternatives to *stop* are lexically specified, focus on *stop* does not lead the listener to infer that the speaker is not certain about the pre-state content. Thus, Abusch's (2002, 2010) analysis does not appear to predict lower-than-ceiling ratings when *stop* is focused. However, given that verum focus can lead to non-projection, Abusch's (2002, 2010) analysis correctly predicts that projectivity is lower when the auxiliary is focused than when *stop* is focused.

On Romoli's (2011, 2015) analysis, the projectivity of the pre-state content of *stop* is derived as a scalar implicature (see also Chemla, 2009). Romoli takes the lexically specified alternative of *stop* to be *used to*: thus, the set of alternatives associated with the sentence *Sam stopped smoking when he turned 18* is the set Alt_1:{Sam stopped smoking when he turned 18, Sam used to smoke before he turned 18}[14] and the set of alternatives associated with the negated sentence *Sam didn't stop smoking when he turned 18* is the set Alt_2:{Sam didn't stop smoking when he turned 18, Sam didn't used to smoke before he turned 18}. Romoli assumed that scalar implicatures arise as entailments of exhaustified sentences (e.g., Chierchia et al., 2012) and he also assumed that both answers of a polar question are exhaustified. Consider now the polar question in (18), repeated below for convenience. Under Romoli's analysis, (18) denotes the set of exhaustified alternatives in (22). Exhausification of the first alternative proposition in (22) affirms the (positive) proposition p in the scope of the exhaustification operator EXH and negates those alternatives in Alt_1 whose negation is consistent with p, i.e., none of the propositions in Alt_1 are negated. Exhaustification of the second alternative proposition in (22) affirms the (negated) proposition p in the scope of the exhaustification operator EXH and negates those alternatives in Alt_2 whose negation is consistent with p. Here, exhaustification negates the proposition that Sam didn't used to smoke before he turned 18, i.e., affirms that Sam used to smoke before he turned 18. Because the proposition that Sam used to smoke before he turned 18 follows from both exhaustified alternatives in (22), the pre-state content is predicted to project.

(18) Did Sam stop smoking when he turned 18?

(22) {EXH[Sam stopped smoking when he turned 18], EXH[Sam didn't stop smoking when he turned 18]}

Romoli (2015: 201) assumed that the pre-state content projects "unless we have information in the context that the speaker is ignorant about it". Given what we have said above about the possibility of deriving non-projection from information about focus-induced inferences about

[14] It may be better to characterize this alternative as the proposition that Sam smoked before he turned 18, because *used to* implies a change of state, but we stick here with Romoli's specification of the alternative.

the QUD, this suggests that Romoli's (2011, 2015) analysis could account for the observed lower-than-ceiling ratings, at least when an expression other than *stop* is focused. However Romoli (2015: 200) also assumed that the projection of soft presuppositions, including the pre-state content of *stop*, cannot be suspended by considerations about whether the pre-state content is relevant to the question under discussion: "relevance is not taken into account and exhaustification has to always happen on the entire set of alternatives". This suggests that focused-induced inferences about the question under discussion are predicted to not influence the projectivity of the pre-state content of *stop*, contrary to the findings of our experiment.

On Abrusán's (2011, 2016) analysis, entailments that are not about the event time of the matrix predicate are backgrounded and therefore project unless they are "the most direct answer to the (grammatically signalled) background question" (Abrusán, 2011: 511). Because focus can induce inferences about the QUD, Abrusán's analysis appears to predict that the projectivity of the pre-state content of *stop* is not at ceiling. However, Abrusán (2016) did not consider how focus could suspend the pre-state content of *stop* because she assumed that the pre-state content "cannot be suspended that easily" (p.193). This assumption runs contrary to the findings of our experiment and that of Tonhauser et al. (2018), where the pre-state content of *stop* was significantly less projective than other presuppositions. As for the second finding of our experiment, it is unclear whether this finding is accounted for under Abrusán's analysis, given that focus on both expressions is compatible with non-projection, as discussed above.

The last analysis we consider is the one proposed in Beaver et al. (2017): here, the pre-state content projects if and only if it is not at-issue with respect to the QUD (see also Simons et al. (2010); Tonhauser et al. (2018)). As with Abrusán's analysis, this analysis allows for focus-induced alternatives about the QUD to correctly predict that the projectivity of the pre-state content is not at ceiling. However, this analysis, too, does not appear to predict that the projectivity is lower with focus on the auxiliary than with focus on *stop*. In sum, none of the analyses currently on the market correctly predict the findings of our experiment for the pre-state content of *stop*. Some analyses correctly predict the first but not the second finding (Beaver et al., 2017; Djärv and Bacovcin, 2017) and others predict the second but not the first one (Abusch, 2002, 2010). A third set of analyses, like that in Romoli (2011, 2015), do not appear to predict either finding. The status of Abrusán's (2011, 2016) analysis is unclear, as discussed above.

4.4. General discussion

Linguistic research on projective content is driven by the goal of deriving the projectivity of such content from its empirical properties and to account for these properties. Over the past decades, different analyses have been developed for projective contents that differ in their empirical properties: the analysis in Heim (1983) was developed for presuppositions, that in Potts (2005) for conventional implicatures, and that in Abrusán (2013a) for focus-derived projective content. Our understanding of the empirical properties of projective content has been increasing steadily. We now know that the projectivity of utterance content is influenced by a variety of factors, including the meaning of the expression associated with the content (e.g., Karttunen, 1971; Tonhauser et al., 2018), contextual information including perspectival information (e.g., Gazdar, 1979; Harris and Potts, 2009), information structure (e.g., Beaver, 2010; Tonhauser, 2016 and this paper) and at-issueness (e.g., Tonhauser et al., 2018). This increased understanding presents an opportunity to assess projection analyses for whether they can capture the observed empirical properties and how, if necessary, they need to be refined.

The preceding three sections assessed projection analyses with respect to the findings of our experiment about the prejacent of manner adverbs, the prejacent of *again* and the pre-state content of *stop*. The discussion was shaped by two recurring themes. The first one was that empirically adequate analyses of these three contents need to consider the influence of prosodically marked information structural focus as well as also the influence of other factors. For the prejacent of manner adverbs, for instance, the focus-based analyses in Abrusán (2013a) and Stevens et al. (2017) correctly predict that the prejacent is more projective with focus on the manner adverb than with focus on another expression. But other factors, like general pragmatic reasoning about alternative utterances, are needed to predict that the prejacent was at least weakly projective across all four focus conditions. Likewise for the prejacent of *again*: to correctly predict its projectivity, overall and across the four focus conditions, it is insufficient to assume that the prejacent must be entailed by or satisfied in the common ground of the interlocutors. Rather, an empirically adequate analysis must allow prosody to influence projectivity.

The second recurring theme was that the projectivity of the three contents is gradient: projectivity was higher or lower in some focus conditions than others, but never at floor or ceiling. For instance, even though the projectivity of the prejacent of manner adverbs was lowest overall, it was always at least weakly projective, compared to the controls. This finding is in line with Tonhauser et al.'s (2018) finding that projectivity is a gradient property of utterance content. A methodological implication is that research on projectivity must take caution to not rely on the intuitions of too few language users in developing empirical generalizations about the projectivity of particular utterance content. For instance, even though a particular listener may take the speaker of a particular utterance to be fully committed to the truth of the prejacent of *again*, the projectivity of the prejacent in that utterance may not be maximal for other listeners.

In sum, the findings of our experiment have revealed a number of properties of the prejacent of manner adverbs, the prejacent of *again* and the pre-state content of *stop* that call for refinements of projection analyses currently on the market. This conclusion may be less surprising for the pre-state content of *stop*, for which several different types of analyses have been developed. But the prejacent of manner adverbs and the prejacent of *again* are generally taken to be prototypical contenders for focus-based and lexicalist projection analyses, respectively. Yet here, too, we found that their empirical properties are not fully predicted.

5. Conclusions

Projective content is heterogeneous and research over the past decades has identified several properties on which projective contents differ from one another (e.g., Chierchia and McConnell-Ginet, 1990; Kadmon, 2001; Potts, 2005; Tonhauser et al., 2013, 2018). This paper investigated three projective contents that have been taken to differ from one another in their projectivity and the sensitivity of their projectivity to information structural focus. Although our experiment confirmed that the prejacent of *again*, the prejacent of manner adverbs and the pre-state content of *stop* differ along these two dimensions, some of the findings were unexpected, given the projection analyses typically assumed for these contents, and are therefore not accounted for by such analyses. Empirically adequate projection analyses, we argue, must take into consideration that many factors jointly contribute to determining the projectivity of utterance content.

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Co-anchoring with the matrix clause: French verbal mood and German V2[1]

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Abstract. In complement clauses, the French indicative and German V2 place similar semantic restrictions on their matrix verbs. In adjunct clauses, the French indicative and German V2 differ: French indicative adjunct clauses can be genuinely embedded, German V2 adjunct clauses cannot, and must follow their host clause. The analysis builds on a decomposed left periphery with *Force* > ... > *Fin* (Rizzi, 1997). The similarity in complement clauses is reduced to an attitudinal anchor [i] with a verbal mood feature in Fin, which is shared by the French indicative and German V2. The presupposition of this feature, due to Schlenker (2005), restricts the matrix verbs. The difference in adjunct clauses is argued to support a new mechanism for how the index [i] of this presupposition connects to the perspective holder in the matrix clause. Modifying a suggestion of Heim (2005), movement of Fin[i] to Force is argued to create a relative clause structure for perspective, interpreted by predicate abstraction. Where it occurs, it can take the matrix verb as its "external head". For French, this leads to an account of embedded indicative adjunct clauses. In addition, the distribution of indicative vs. subjunctive in indefinite relative clauses (Farkas, 1985) is explained. For German V2, the restriction on adjunct clauses follows if German V2 is an overt instance of perspectival relative clause formation. This is connected to independently motivated properties of verb movement in V2-clauses, in an extension of the suggestions of Sode and Truckenbrodt (2018).

Keywords: verbal mood, V-to-C movement, attitude verbs, perspective, French, German.

1. A comparison of the French indicative with German V2

This section introduces some similarities and differences between the French indicative and German V2 order. The remainder of the paper motivates an analysis of verbal mood that leads to an account of the observations in this section.

1.1. Similarities in complement clauses

In French, indicative verbal mood is a central component of a declarative. In German, V2 word order is a central component of declaratives. Both can also occur in the complement clause of the verbs *say*, *believe*, and *dream* as shown in (1) and (2) (see Meinunger, 2004 and Portner, 2006 on the parallel). In French, the indicative regularly excludes the use of subjunctive for expressing the same meaning (Portner, 1997; Schlenker, 2005). In German, embedded V2 clauses exist side by side with embedded V-final clauses, the standard shape of em-

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bedded clauses (Reis, 1997). They express the same meaning in the cases relevant here. The German clauses are shown with both indicative and reportative subjunctive (morphologically Konjunktiv I), which also carry the same meaning in the embedded clauses relevant here.

(1) a. Jean dit / pense que Léa **est**/***soit** là.
Jean says / thinks that Léa is.IND/SBJV there

b. Jean rêve que Léa **est**/**soit** là. (*sbjv*: only irrelevant wish-reading)
Jean dreams that Léa is.IND/SBJV there

(2) Lukas sagt/glaubt/träumt, Lisa **ist/sei** da / dass Lisa da **ist/sei**.
Lukas says/believes/dreams Lisa is.IND/KONJ there / that Lisa there is.IND/KONJ
'Lukas says/believes/dreams that Lisa is there.'

The matrix predicates *want*, *demand*, and *it is possible* embed neither French indicative nor German V2. In French, the subjunctive must be used in the complement clause, as in (3) and (4). In German, a V-final clause must be employed, as in (5) and (6).

(3) Luc veut/demande que Léa ***est**/✓**soit** là.
Luc wants/demands that Léa is.IND/SBJV there

(4) C'est possible que Léa ??**est**/✓**soit** là.
It-is possible that Léa is.IND/SBJV there

(5) Lukas will/fordert, dass Lisa da **ist/sei** / Lisa ***ist**/*/??**sei** da.
Lukas wants/demands that Lisa there is.IND/KONJ / Lisa is.IND/KONJ there
'Lukas wants/demands that Lisa is there.'

(6) Es ist möglich, dass Lisa da **ist/sei** / Lisa ***ist**/***sei** da.
it is possible that Lisa there is.IND/KONJ / Lisa is.IND/KONJ there
'It is possible that Lisa is there.'

On Romance indicative, see also Farkas (1985, 1992), Quer (2001), Giannakidou (2009), Schlenker (2005), and Portner (2011, 2018). On German V2, see also Gärtner (2000, 2002), Truckenbrodt (2006a, b), and Sode and Truckenbrodt (2018).

1.2. Differences in adjunct clauses

I subsume relative clauses and adverbial clauses under the term adjunct clauses. They are not selected. The similarity between French and German does not extend to these. French indicative adjunct clauses can occur in embedded positions. Thus, the French indicative is the standard mood in restrictive relatives inside definite and quantified DPs as in (7) and (8).

(7) Le touriste [à qui j'**ai** parlé] vient de Québec.
the tourist to whom I-have.IND talked comes from Quebec
(Hawkins and Towell, 1996:356)

(8) Il n'y a personne [qui **vient** me voir]. (Lalaire, 1998:320)
it not-there has nobody who comes.IND me see
'There is nobody who is coming to see me.'

Further, French indicative adverbial clauses can be in the scope of a matrix clause negation:

(9) [Pierre boit cette mixture, parce qu'elle est bonne.]
'Pierre drinks this mixture because it is.IND good.'

Il ne la boit pas [parce qu'elle **est** belle]. Neg >> Cause
he NEG it drinks NEG because C-it is.IND pretty
'He doesn't drink it because it is.IND pretty.'

In German, on the other hand, restrictive relative clauses with definite and quantified DPs are allowed with V-final word order, but not with V2 word order (Gärtner, 2000).

(10) Das ist der Tourist, mit dem ich gesprochen **habe** / *mit dem **habe** ich gesprochen.
that is the tourist with whom I talked have / with whom have I talked
'That is the tourist to who I talked.'

(11) Es gibt niemanden, der mich besuchen **kommt** / *der **kommt** mich besuchen.
it exists nobody who me visit comes / who comes me visit
'There is nobody who comes to visit me.'

Similarly, German adjunct clauses embedded under negation can only have V-final word-order as in (12) and not V2 word order as in (13) (see Wechsler, 1991 for Swedish, Antomo and Steinbach, 2010 for German).

(12) [Peter trinkt die Mixtur, weil sie gut schmeckt.]
'Peter drinks the mixture because it tastes good.'

Er trinkt sie nicht, [weil sie gut **aussieht**]. Neg >> Cause
he drinks it not since it good PRT.looks
'He does not drink it because it looks good.'

(13) [Peter trinkt die Mixtur, weil sie gut schmeckt.]
'Peter drinks the mixture because it tastes good.'

a. #Er trinkt sie nicht, weil [sie **sieht** gut **aus**]. * Neg >> Cause
he drinks it not since it looks good PRT

b. #Er trinkt sie nicht, denn [sie **sieht** gut **aus**]. * Neg >> Cause
he drinks it not since it looks good PRT

There are, arguably, both German V2 relative clauses and V2 adverbial clauses (Gärtner, 2000). For example, (11) is grammatical with V2-order in the relative clause if *niemanden* 'nobody' is replaced with *jemanden* 'somebody'. Further, (13a,b) are acceptable in other contexts, where the V2 adjunct clause scopes over the matrix clause negation. These V2 relative clauses and V2 adverbial clauses clauses obey fairly strict restrictions: They are assertive in nature, must not be genuinely embedded, which is relevant here, and they must follow their host clause (Gärtner, 2000; Hinterhölzl, in press; see also Wechsler, 1991).

Why are the two phenomena similar in complement clause position, but different in adjunct clauses? The distinction is argued to motivate a new element in the theory of logophoricity.

2. Elements of the analysis

The morphosyntactic underpinnings of the analysis of verbal mood and V2 are first introduced in sections 2.1 and 2.2. They provide a crucial frame for the argument for *p-relativization*, an analysis of how some logophoric elements find their antecedents outside of the CP. After the introduction of semantic elements of the analysis in sections 2.3. and 2.4, the following sections 3 and 4 develop p-relativization and its applications.

2.1. Background to the morphosyntactic analysis of verbal mood

Schlenker (2003, 2005) developed a logophoric analysis of verbal mood. The representation of verbal mood included an index and verbal mood features. The index and the features were attached to syntactic world variables in situ, close to the occurrence of the verbal mood morphology. Sode and Truckenbrodt (2018) developed a revised logophoric account of German verbal mood and V-to-C movement from elements of Schlenker's account. This account is illustrated in (14), using an English sentence as a model for the French examples in (1a). The index is here located in C. Like the index in Schlenker (2003), it refers to anchors (or contexts) of the form ‹x,t,w›, which are simplified to ‹x,w› below.[2] (14) shows that this index relates the verbal mood interpretation to the matrix clause – in this illustration: to the matrix verb. The index in C carries interpreted verbal mood features, here the feature [+bel]. It is in a syntactic agree-relation with a corresponding uninterpreted verbal mood feature on the finite verb. [+bel] relates the index to beliefs and occurs on declaratives. [-bel] relates the index to preferences and is present in imperatives.[3]

(14)

verbal mood interpretation | verbal mood morphology

Luc believes$_{[i]}$ that **[i][+bel]** Lea **is[+bel]** there.

coindexing see Schlenker (2005) | agree-relation and features, see Sode and Truckenbrodt (2018), building on Schlenker (2003, 2005)

Sode and Truckenbrodt also employ a second verbal mood feature [±origo] for German. For example, the imperative inherently expresses an actual request by the speaker at the speech-time in German (see e.g. Schwager, 2006). The imperative operator is [i][-bel][+origo]. Here [-bel] relates the index to preferences and [+origo] requires that the index refers to the

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2 Schlenker (2005) proposed indices that refer to speech- or thought-events. In early talks of the current author and in Sode (2014), it is argued that beliefs are indexed.

3 The features of Sode and Truckenbrodt (2018) – in terms of beliefs on the one hand and reference to Kaplan's context on the other–draws on the meaning of the feature [±indicative^{2*}] of Schlenker (2003) and on the meaning of the French indicative in terms of an anchored context set in Schlenker (2005).

utterance context (Kaplan, 1989), so that ‹x,t,w› = ‹c_{Sp},c_T,c_W›. In German, the feature [-origo] characterizes the reportative Konjunktiv, which is [i][+bel][-origo], i.e. relates to beliefs of a third person or past beliefs or modally shifted ones (see Schlenker, 2003, and for detailed argumentation Sode, 2014). The German indicative in C is tentatively classified as [i][+bel][+origo] by Sode and Truckenbrodt; there is evidence in many configurations that it is specialized to the expression of actual speaker-beliefs, though there are two as yet not well-understood exceptions to this; one of them is the occurrence under the verbs in (2), where the indicative relates to the beliefs of the matrix subject. The other one may be described as involving sentences like in (2), though with the matrix clause turned into a V1-parenthetical. All this is distinct from the French indicative, which is, in an obvious way, not specified for [±origo], i.e. it can relate to actual beliefs by the speaker or to other beliefs alike.

In the theory of Chomsky (2008), an agree-relation is a prerequisite for overt movement. The agree-relation may also occur without movement. This is the case in (14), the model of the French examples in (1a). The finite verb stays in situ. On the other hand, the agree-relation may be followed by overt movement. Sode and Truckenbrodt argue that German V-to-C movement is correlated with an agree-relation for verbal mood. This is illustrated in (15), following the assumptions about feature interpretability and valuation in Pesetsky and Torrego (2007). The German indicative is the feature combination [+bel][+origo], as in (15a). The output of agree and move is shown in (15b): the features in C receive the values [+bel][+origo] from the finite verb via agree and the finite verb *hat* 'has' is in C. Movement to Spec,CP is shown in (15c). (German V2 is standardly analyzes as a combination of V-to-C movement and movement to Spec,CP. Underlyingly, the verb is in clause-final position.)

(15)	a.	C-[i][±bel][±origo]	es gestern geregnet **hat[+bel][+origo]**
			it yesterday rained has.GERMAN-IND
	b.	C-[i][**+bel][+origo]-hat**	es gestern geregnet
	c.	**Es** C-[i][+bel][+origo]-hat	gestern geregnet
		'It rained yesterday.'	

Genuinely embedded V-final clauses in German (such as restrictive relatives or embedded adjunct clauses) do not carry [i] in C in the account of Sode and Truckenbrodt. The reader is referred to Sode and Truckenbrodt (2018) for suggestions about the licensing of the finite morphology in V-final clauses in terms of long-distance agree relations, not relevant here.

2.2. Morphosyntactic developments of the earlier accounts

The current comparison of French and German suggests refinements of the morphosyntactic analysis, which are laid out in this section.

The distinction between French indicative and German V2 is in part correlated with a distinction in root clause status. German V2-clauses are root clauses (Hooper and Thompson 1973, Heycock 2006): they don't occur in embedded positions except as complements to the class of verbs illustrated in (2). French indicative, on the other hand, is not a root phenomenon, since it can occur in genuinely embedded positions, such as in restrictive relatives and genuinely embedded adverbial clauses. In the split CP analysis of Rizzi (1997), Haegeman (2004) argues that root clauses are ForcePs with speaker anchoring in their Force head. In the analysis of Sode and Truckenbrodt (2018), the index-feature combination [i][±bel][±origo] is developed as a way of making Haegeman's speaker anchoring in Force concrete.

In the current comparison with French, the analysis of the preceding section is refined. The new elements are given in (16) – (18). The different lexical specifications for core verbal mood categories are shown in (16). I hypothesize that [i][±bel] is located in Fin and that [±origo] is located in Force, as shown in (17). I further hypthesize that Force[±origo] attracts overt movement, while Fin[±bel] does not, as in (18), across French and German.

(16)	a. German verbal mood specifications (from Sode and Truckenbrodt 2018)	imperative:[-bel][+origo] indicative: [+bel][+origo] rep. Konjunktiv: [+bel][-origo]	
	b. French verbal mood specifications	imperative: [-bel][+origo] indicative: [+bel] subjunctive: Ø	(see below) (see below)

(17)	Force [±origo]	Fin [i][±bel]	TP

(18) An agree-relation involving [±origo] in Force requires overt movement to Force.

The French indicative is specified for [+bel] but not for [±origo]. It thus requires only a Fin-head Fin[i][+bel] to agree with. The Force layer with [±origo] does not need to be invoked. Consequently, French indicative clauses do not need to be root clauses. By contrast, the German indicative and Konjunktiv (as well as the imperative) are specified for [+/-origo][4] in situ. In V1/V2-clauses, this enters into an agree-relation with [±origo] in Force. By (18), this will trigger overt movement to Force, i.e. V-to-C movement. The resulting clauses are ForcePs, i.e. root clauses.[5]

This little system receives initial support from a comparison with the French imperative. It is arguably specified for [+origo] – it is inherently tied to a speaker-request to the addressee at the time of speech. The [+origo] specification agrees with [±origo] in Force. By (18) this requires overt movement of the imperative to Force. This expectation is borne out. The French imperative verb moves to C in non-negated imperatives (Hulk, 1996). This results in inversion of the verb with all clitic pronouns. Thus, while the indicative verb in situ follows clitic pronouns as in (19a), the non-negated imperative precedes them as in (19b).

(19)	a. Tu you	le it	lui her/him	donnes give.IND	b.	Donne-le-lui give.IMP-it-her/him

[4] I write [+/-F] for indicating 'either value' and [±F] for indicating 'no value' (or in "the feature [±F]").

[5] This analysis is compatible with the V2 typology of Wolfe (to appear), in which German V2 involves the finite verb in Force, while a range of medieval Romance languages moved the finite verb to Fin without moving it to Force. The trigger of movement to Fin in these medieval Romance language remains open here.

We thus have the following clausal heads, with overt movement (or its absence) following from the lexical verbal mood specifications (16) and from (18) in this limited domain:

(20) French indicative: Fin[i][±bel] ... V[+bel]
- no overt movement to Fin required by (18)

French imperative: Force[±origo] Fin[i][±bel] ... V[-bel][+origo]
- overt movement of imperative verb to Force due to (18)

German V2-clause: Force[±origo] Fin[i][±bel] ... V[+/-bel][+/-origo]
- overt movement of finite verb to Force due to (18)

Hooper and Thompson (1973) showed that the distribution of root clauses is semantically restricted: they occur in assertive environments. This allows them to occur as complements to assertive-like verbs such as the ones in (1) and (2) and it allows them to occur unembedded (such as in declaratives), where they are themselves asserted. We are thus out for a semantic account of the restrictions on V2-clauses and the distinction to the French indicative. The classification as ForcePs is merely a syntactically motivated starting point for this, not yet an account of the restrictions on their embedding.[6] [7]

I also briefly address the filling of Spec,ForceP in deriving the German V2 word order. I follow essentially Tsiknakis (2016), in different terms. Setting wh-phrases and relative pronouns aside, the configuration [i][+bel][+/-origo] in a declarative attracts an element to Spec,ForceP. In (21), I assume that Force[i][+bel][+/-origo] is formed by V-to-C movement.

(21) In the absence of an interrogative Q, the configuration [i][+bel][+/-origo] in Force requires filling Spec,ForceP in German.

Thus, the V2 clause type is the standard declarative ([i][+bel][+/-origo]), while V1 clause types are imperatives ([i][-bel][+origo]) and yes-no questions, which have interrogative Q.

The following structural similarities and differences will be important:

(22) a. The French indicative and German V2 share the specification [i][+bel] in Fin.
b. German V2 requires movement to Force[±origo]; the French indicative does not.

2.3. Background to the semantic analysis

Portner (1997) and Schlenker (2005) argued that the French indicative is semantically interpreted, and that the subjunctive has no meaning and is used when the indicative cannot

[6] Next to V2-clauses (ForcePs with V-to-C) German also has V-final root clauses (ForcePs without V-to-C), see Truckenbrodt and Sode (in press). In the current paper, I focus on German V2 and the French indicative.

[7] The account in Sode and Truckenbrodt (2018) is the first formal semantic account of root clauses. In this account, root clauses are ForcePs headed by [i]. A refinement is called for in the comparison with the French indicative, which shares the root clause restrictions in complement clauses but not in adjunct clauses.

be employed to express the same meaning. Schlenker (2005) attributed the competition to *maximize presupposition* (Heim 1991). These suggestions are adopted here (see (16b)). I leave open why there is no comparable competition between V2 and V-final German clauses.

In the analysis of Romance verbal mood by Farkas (see e.g. Farkas, 1985, 1992), beliefs and the truth of a proposition for an individual play a central role. Fictional predicates like *dream* are discussed as unexpected members of the same family of predicates – one does not take to be true what one dreams – to which the notions can nevertheless be extended. This line of thought is devevoped in terms of formal individual models and the notion of veridicality in the writings of Giannakidou (see e.g. Giannakidou, 2009). Portner (2018) remarks that arbitrariness arises in drawing a line, in these terms, between e.g. dreaming and wanting.

This might be improved if these intuitions are pursued in connection with the decomposition of attitudinal meanings (see e.g. Heim, 1992; Kratzer, 2006; Sauerland and Yatsushiro, 2017). In this spirit, Sode and Truckenbrodt (2018) suggest that the distribution of German V2 in complement clauses can be captured as outlined in (23).

(23) V2 in a complement clause requires embedding immediately under a belief-component of the matrix verb.

Thus verbs that allow embedded V2 clauses have plausible decompositions with belief as the lowest meaning component, as shown for the verbs in (1) and (2) in (24).

(24) a. <u>x believes p</u>
b. x asserts p ≈ x expresses that <u>x believes p</u> (see Searle, 1975)
c. x dreams p ≈ in x's sleep, <u>x believes p</u> (see Heim, 1998)

Predicates that do not allow embedded V2 either have no belief-component in their meaning, or they have it in such a way that it does not immediately embed the complement clause, as shown in (25) for two of the predicates in (3) – (6). This is pursued in the following.

(25) a. it is possible that p
b. x wants p ≈ <u>x believes</u> that x is better off if <u>p</u> than if not <u>p</u>.
(Heim 1992; slightly adapted for space reasons)

2.4. The presupposition of Schlenker (2005) and the interpretation of Fin[i][+bel]

I assume that a finite *that*-clause under the verb *believe* – without verbal mood – has a standard meaning as in (26). I omit temporal specifications throughout. I write dox(‹m,w›) for the set of doxastic alternatives of Mary in world w, and I refer to ‹m,w› as their *anchor*.

(26) $[\![\text{Mary believes that it is raining}]\!]^{g,c} = \lambda w\ \forall w'\ [\ w' \in dox(\langle m,w\rangle) \rightarrow rain(w')\ ]$

Relative to this, the presupposition that is added by the French indicative in the account of Schlenker (2005) is illustrated in (27). The presupposition is underlined in (27b).

(27) a. ⟦Mary believes$_{\mathbf{i}}$ [that-IND$_{\mathbf{i}}$ it is raining]⟧^{g,c} =
b. $\lambda w\ \forall w'$ [$w' \in dox(\langle \mathbf{m,w} \rangle) \rightarrow \underline{w' \in dox(\langle \mathbf{m,w} \rangle)}$. $rain(w')$]

Before addressing the presupposition, I point out the net effect of the coindexing in (27a) for the meaning in (27b). It is highlighted by boldfacing in (27b): the anchor of the matrix verb is identical to the anchor of the embedded indicative.

The underlined presupposition in (27b) now requires that the world w', over which the embedded clause is predicated, is an element of the doxastic alternatives at the co-indexed anchor. This presupposition can be taken to be satisfied in (27b), since it is entailed in (27b). Therefore, the French indicative can be used in this sentence.

I will use this presupposition for concreteness here.[8] I interpret [i][+bel] in Fin by the syncategorematic rule in (28), which makes use of this presupposition.

(28) ⟦Fin[i][+bel]⟧^{g,c} = $\lambda p\ \lambda w$: $\underline{w \in dox(g(i))}$. $p(w)$

For an embedded FinP with the structure in (29a), we thus derive the meaning in (29b).

(29) a. [$_{\text{FinP}}$ Fin[i][+bel] it rains[+bel]]
b. ⟦ [$_{\text{FinP}}$ Fin[i][+bel] it rains[+bel]] ⟧^{g,c} = λw: $\underline{w \in dox(g(i))}$. $rain(w)$

The presupposition in (28) is logophoric in the sense used here, insofar as it relates to the perspective holder of the clause: the referent of [i] is ‹x,t,w› (simplified to ‹x,w›), the coordinates of the perspective holder.

3. P-relativization

3.1. The syntax of p-relativization

I turn to the issue how such a logophoric index in an embedded clause is formally connected to the perspective holder in the matrix clause. In (27), this was mediated by co-indexing with the matrix verb. However, if we employ such coindexing, as does Schlenker (2005), obstacles arise in cases where the attitude holder is quantified over, such as in *everyone believes p*, as pointed out by Eckardt (2015a).

Another formal way of connecting embedded elements to properties of the matrix verb is employed by Sharvit (2004), Yalcin (2007), Anand and Hacquard (2013), and Eckardt (2015b): these authors make a formal connection via an additional parameter of the interpretation function.

I here develop a different analysis of this connection. It takes inspiration from a suggestion in Heim (2005). She employed an unusual syntactic analysis in which the matrix verb (with its subject argument) originates in the embedded clause and moves out of it, creating a structure

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8 An alternative, closer to Farkas (1985, 1992), Giannakidou (2009), and Truckenbrodt (2006a,b) is:
(i) ⟦Fin[i][+bel]⟧^{g,c} = $\lambda p\ \lambda w$: $\underline{dox(g(i)) \subseteq p}$. $p(w)$ (underlined: not pre- but post-supposition here)

in which predicate abstraction relates the embedded clause to the matrix verb. I adapt this as sketched in (30): Fin[i] moves to Force within the complement clause. Like movement of a relative pronoun, this creates an operator-variable structure with the index [i], to be interpreted by predicate abstraction (Heim and Kratzer, 1998). I call this *p-relativization*, the "p" suggesting "perspective". I further assume that the relative clause structure requires an external head, like standard relative clauses have an NP external head, and that the standard external head of p-relativization is the matrix verb – more specifically its anchor.

(30) Mary thinks [$_{CP}$ Force Fin it is raining]
$\langle x,t,w \rangle$ [i]

movement of Fin[i] to Force: *p-relativization*

The adaptation also integrates an element of the suggestions by Kratzer (2006), Moulton (2015), and Elliott (2017). For them, complement clauses are nominal modifiers. In the current adaptation, the complement in (30) similarly has a relative clause structure. However, in (30), this is here only a secondary aspect of the interpretation of the complement clause.

In German V2 clauses, I take p-relativization to be an inherent part of V-to-C movement: the finite verb (carrying [+/-bel][+/-origo] in German) moves to T, then T moves to Fin[i][±bel], then Fin[i][+/-bel] moves to Force[±origo]. The interpreted aspects of this are (a) the features [±bel] in Fin and [±origo] in Force receive values from the moving finite verb (technically by agree accompanying this movement) and (b) the movement from Fin to Force includes movement of the index [i], as shown in (30), and thus p-relativization.

3.2. The semantic interpretation of p-relativization

(31) shows the to-be-interpreted essence of a structure in which Fin[i] has moved to Force. The moved index is in Force. [+/-origo] can be interpreted on the index in Force. [i][+/-bel] will still be interpreted in Fin by (28). (Syntactically, I assume that the moved Fin[i][+/-bel] leaves behind a copy (Chomsky, 1993), which is interpreted in its original position.)

(31) [$_{ForceP}$ Force[i][+/-origo] [$_{FinP}$ Fin[i][+/-bel] it rains]]

In parallel to Heim (2005), I interpret the moved structure in terms of predicate abstraction, which is also used for relative pronouns in Heim and Kratzer (1998). I formulate the specific version in (32) for this, which also interprets [+/-origo]. The "..." allow for irrelevant syntactic structure due to head movement to Force. I write *context* for the semantic type of context-triples $\langle x,t,w \rangle$, here simplified to $\langle x,w \rangle$, and I use *a* as a semantic variable of this type.

(32) Predicate abstraction for [i][+/-origo]

a. $[\![\ [\ [_{Force} \ldots \mathbf{[+origo]} \ldots [i] \ldots]\ FinP]\ ]\!]^{g,c}$ is defined if $\mathbf{g(i) = \langle c_{Sp}, c_{W} \rangle}$.
b. $[\![\ [\ [_{Force} \ldots \mathbf{[-origo]} \ldots [i] \ldots]\ FinP]\ ]\!]^{g,c}$ is defined if $\mathbf{g(i) \neq \langle c_{Sp}, c_{W} \rangle}$.
c. If it is defined, then for all g and c:
$[\![\ [\ [_{Force} \ldots [+/-origo] \ldots [i] \ldots]\ FinP]\ ]\!]^{g,c} = \lambda a \in D_{context}\ [\![\ FinP]\!]^{g[i \rightarrow a],c}$

The interpretation of (31) is shown in (33), here putting aside the interpretation of [+/-origo]. In the first step, predicate abstraction creates a lambda abstract over *a*, with [i] in the meaning of the FinP mapped to *a*. In the second step, Fin[i][+bel] is interpreted, with g(i) = a.

(33) $\llbracket\ [_{\text{ForceP}}\ \text{Force[i]}\ \ [_{\text{FinP}}\ \text{Fin[i][+bel]}\ \ \text{it rains}\ ]]\ \rrbracket^{g,c}$

$= \lambda a\ \ \llbracket\ [_{\text{FinP}}\ \text{Fin[i]}\ \ \text{it rains}\ ]\ \rrbracket^{g[i \rightarrow a],c}$ (by (32))

$= \lambda a\ \ \lambda w\text{: } \underline{w \in \text{dox}(a)}\ .\ \text{rain}(w)$ (with (28))

I turn to the connection between the complement clause (33) and the matrix verb. This complement clause is now both a semantic complement of the matrix verb and a structure with p-relativization. Formally, we can take both into account if we adopt a suggestion of Kaplan (1989:554), which is also pursued in Eckardt (2015a) for the representation of indirect speech. Kaplan suggested that a class of verbs including *say* and *believe* take a character (a function from contexts to propositions) as their complement. Its context argument is what I here call the anchor of the matrix verb (boldfaced in (34)). In (34), I allow this for the verb *believe* as a second meaning option in (34b) in addition to the regular meaning in (34a).

(34) P-relativization can connect to the matrix verb *believe* by option (b)

$\llbracket \text{believe} \rrbracket^{g,c}$ = a. $\lambda p_{<s,t>}\ \lambda x\ \lambda w\ \forall w'\ [\ w' \in \text{dox}(\langle \mathbf{x,w} \rangle) \rightarrow p(w')\ ]$

or = b. $\lambda \phi_{<\text{context},<s,t>>}\ \lambda x\ \lambda w\ \ \forall w'\ [\ w' \in \text{dox}(\langle \mathbf{x,w} \rangle) \rightarrow \phi(\langle \mathbf{x,w} \rangle)(w')\ ]$

whichever fits the semantic type of the complement

(35) shows how (34b) combines with (33) to give the desired result.

(35) $\llbracket\ \text{believe [Force[i] Fin[i][+bel] it rains]}\ \rrbracket^{g,c} =$

$[\ \lambda \phi_{<\text{context},<s,t>>}\ \lambda x\ \lambda w\ \ \forall w'\ [\ w' \in \text{dox}(\langle \mathbf{x,w} \rangle) \rightarrow \phi(\langle \mathbf{x,w} \rangle)(w')\ ]\ ]$

$(\lambda a\ \lambda w''\text{: } \underline{w'' \in \text{dox}(a)}\ .\ \text{rain}(w''))$

$= \lambda x\ \lambda w\ \ \forall w'\ [\ w' \in \text{dox}(\langle \mathbf{x,w} \rangle) \rightarrow\ \ \underline{w' \in \text{dox}(\langle \mathbf{x,w} \rangle)}\ .\ \text{rain}(w')\ ]$

Let us assume that the verbs *say* and *dream* in (24) also allow such a second meaning for their belief-component and thus allow embedding of a complement with p-relativization.

P-relativization, embedded in the morphosyntactic analysis above, will be a crucial part in the account of the observations in section 1. This is shown in the following section.

4. Application of the account

4.1. The account of the similarities in complement clauses and in declaratives

I assume that French indicative and German V2 both involve p-relativization in their occurrence in complement clauses, as well as in declaratives. For German V2 clauses, this is inherent, as discussed. For the French indicative, I allow p-relativization optionally. To fit this option with the morphosyntactic account above, I formulate (36).

(36) French: Optionally specify Fin[i][+bel] with [+origo] or [-origo].

When this option is taken, p-relativization is the consequence. Fin[i][+bel][+/-origo] will need to move to Force, where its feature [+/-origo] can be interpreted (cf. (18) and (33)):

(37) French indicative with p-relativization, triggered by the option in (36):

Force[i][+/-origo]   Fin[i][+bel][+/-origo]   Su V[+bel] ...

In complement clauses, this works out in both languages as illustrated in (33) and (35).

In declaratives, I invoke the additional assertive element ASS outside of the ForceP. It functions as the external head of p-relativization. I adopt ASS from Truckenbrodt and Sode (in press). They analyze it as a head in the higher speech-act phrase of Krifka (2015).

(38) ASS Force[i][+/-origo]   Fin[i][+bel][+/-origo]   ...

I give a definition of ASS that is sufficient for the purpose at hand in (39). It is similar to the second meaning of *believe* in (34b), but does not take a subject argument and is instead anchored to the speech context. It will pass on its anchor (the speech context) to the perspectival relative clause, and it can satisfy the presupposition of Fin[i][+bel].

(39) $[\![\text{ASS}]\!]^{g,c} = \lambda\phi_{<context,<s,t>>}\ \forall w'\ [\ w' \in \text{dox}(\langle \mathbf{c_{Sp}},\mathbf{c_W}\rangle) \rightarrow \phi(\langle \mathbf{c_{SP}},\mathbf{c_W}\rangle)(w')\ ]$

The semantic combination of ASS with the perspectival relative clause is parallel to (35).

Gutzmann (2015) argues that such grammar-related speech act components should not be construed as at-issue meanings but as use-conditional. I will return to this aspect of ASS.

4.2. The account of the differences in adjunct clauses

For a French restrictive relative clause with indicative like (7), the structure is shown in (40). The relative clause (in the third line) carries its own Fin[i][+bel]. I assume that it uses the same index [i] as the matrix Fin[i][+bel].

(40) Binding of [i] in an embedded clause with French indicative

Force **Fin[i]**[+bel] the tourist   comes[+bel] from Qu.
  [Fin[i][+bel] to whom I have[+bel] talked]

Fin-to-Force movement in the matrix clause is interpreted in terms of predicate abstraction as in (32) above. This binds the two occurrences of [i] in their respective Fin[i][+bel] heads:

(41) $[\![\ \text{Force[i]}\ [_{\text{FinP}}\ \text{Fin[i]}\ ...\ \text{Fin[i]}\ ...]\ ]\!]^{g,c} = \lambda a\ [\![\ [_{\text{FinP}}\ \text{Fin[i]}\ ...\ \text{Fin[i]}\ ...]\ ]\!]^{g[i\rightarrow a],c}$

The meaning of (40) under ASS is then given in (42).

(42) $[\![$ ASS Force[i] [[i][+bel] the tourist [[i][+bel] to whom I talked] is from Quebec] $]\!]^{g,c}$

$= \forall w' \; [\; w' \in dox(\langle \mathbf{c_{Sp}},\mathbf{c_{W}}\rangle) \rightarrow \underline{w' \in dox(\langle \mathbf{c_{Sp}},\mathbf{c_{W}}\rangle)} \; .$

$from_{w'}(q, \iota\{x \mid tourist_{w'}(x) \wedge [\underline{w' \in dox(\langle \mathbf{c_{Sp}},\mathbf{c_{W}}\rangle)} \; . \; talked_{w'}(c_{Sp}, x)]\}) \;]$

The presupposition of the relative clause is satisfied. Since the relative clause is not separated by an intensional operator from the main clause, the world variable (w’ in (42)) over which the main clause is evaluated is also the world variable over which the relative clause is evaluated. Since, furthermore, the anchors [i] have identical reference, the presupposition of the relative clause is identical to the presupposition of the main clause. Both are satisfied.

Importantly, the account allows that the presupposition of a French indicative relative clause can be satisfied when the relative clause is in an embedded position. It can be satisfied because [i] in Fin[i][+bel] can be bound by a higher occurrence of p-relativization.

This now contrasts in an important way with German V2 clauses. The morphosyntactic underpinnings of the account led us to an analysis in which p-relativization is an inherent property of German V2 clauses. The structure of a hypothetical embedded V2 relative clause, which we seek to rule out, is shown in (43).

(43) No binding of [i] in an embedded clause with German V2

Force **Fin[i]**[+bel] the tourist comes[+bel] from Qu.
Force **[Fin[i]**[+bel] to whom I have[+bel] talked]

It is true more generally that relative clauses do not allow binding of the relative pronoun or of its trace from outside of the relative clause (apart from the local relation to the external head of the relative clause). Therefore, German V2 clauses cannot have the [i] in Force[i] or Fin[i] bound from higher up in the way Fin[i] is bound in the third line of (40) in French.

This follows formally in the account of Heim and Kratzer (1998). Given their rule of predicate abstraction (and this carries over to (32), which interprets p-relativization), an index that is bound by a movement index cannot in addition be bound from higher up. Even if the same index is used for a binding relation higher up, predicate abstraction does not translate such additional co-indexing into a semantic dependency.

We reach similar conclusions if we employ different terms, such as the ones of Chomsky (1981). The index [i] in Fin[i] is in a non-operator position, broadly comparable to A-positions. After movement to Force, [i] in Force[i] is an operator. As an operator, it cannot be bound. Further, its trace [i] is plausibly construed as a variable. If it was bound by a higher instance of [i] in Fin, the configuration would be that of a strong crossover violation.

In this way, the account using p-relativization correctly derives that [i] in Fin[i] in the French indicative can be bound at a distance, while [i] in Fin[i] in German V2 cannot.

I complete the account: p-relativization requires a local connection to an external head of the perspectival relative clause. Where the V2-clause is a complement clause, such a connection can be made to the matrix verb. In V2 adjunct clauses, this is not an option since they are not complements of a matrix verb. The only remaining option in the current account is the deployment of ASS as the external head (as a head in a projection above ForceP).

(44) ASS is required in V2 adjunct clauses as the external head of p-relativization for the anchor in the V2 clause.

The restrictions on V2 adjunct clauses can then be attributed to the presence of ASS:

(45) a. Clauses headed by ASS are interpreted as assertions.
b. Clauses headed by ASS cannot be genuinely embedded.
c. If a clause headed by ASS has a host clause, the clause headed by ASS must follow its host clause.

We can relate the property of ASS in (45b), which is particularly relevant here, to the suggestion of Gutzmann (2015): If the clause headed by ASS does not have at-issue content but only use-conditional content, it cannot be embedded in at-issue content.

These results apply to restrictive relatives and embedded adverbial clauses alike.

4.3. Independent evidence for long-distance binding of [i] with the French indicative

In the structure for French in (40), [i] in Fin[i][+bel] in the embedded relative is bound at a distance due to p-relativization in the matrix clause. Independent evidence for this binding at a distance comes from the distribution of verbal mood in relative clauses in indefinite DPs. Examples like (46) have often been discussed in Romance languages since Quine (1956), see e.g. Quer (2001) for Catalan. The verbal mood in the relative clause varies with the reading.

(46) Nous recherchons un interprête [qui connait/connaisse le Tamil].
We are looking for an interpreter who knows.IND/SBJV Tamil.

If we are looking for a specific interpreter, only indicative is allowed. In this reading, the object scopes over the intensional verb, as in (47). The presupposition of the relative clause (underlined) is satisfied, since the relative clause is evaluated over the same world variable as the main clause. Subjunctive is possible only if the object is in the scope of the intensional verb and we are not assuming that there is an interpreter for Tamil, as in (48). Here the intensional verb shifts the world of evaluation. With the different world variable, the presupposition of the indicative is not satisfied, as shown in (48). Therefore, subjunctive is used. (The scope interaction is due to Quine, 1956; the analysis of *seek* by Montague, 1973 is used; see also Zimmerman, 1992 and Moltmann, 1997 on intensional verbs.)

(47) a. **ASS Force Fin[i]** [an interpreter [**Fin[i]** who knows Tamil]] λ_2 we seek t_2
b. $\forall w\ [\ \mathbf{w} \in \text{dox}(\langle \mathbf{c_S},\mathbf{c_W}\rangle) \rightarrow \exists x\ \text{interpreter}_w(x) \wedge [\underline{\mathbf{w} \in \text{dox}(\langle \mathbf{c_S},\mathbf{c_W}\rangle)}\ .\ \text{know}_w(x, t)]$
$\wedge\ \text{try}_w(c_S, \lambda w'\ \text{find}_{w'}(c_S, x))\ ]$

(48) a. **ASS Force Fin[i]** we seek an interpreter [**Fin[i]** who knows Tamil]
b. $\forall$w [**w** $\in$ dox(‹**c$_S$,c$_W$**›) $\rightarrow$ try$_w$(c$_S$, λw' $\exists$x interpreter$_{w'}$(x)
$\wedge$ [<u>**w'** $\in$ dox(‹**c$_S$,c$_W$**›)</u> . know$_{w'}$(x, t)] $\wedge$ find$_{w'}$(c$_S$, x))]

The "distance" between the matrix clause Force[i] that undergoes p-relativization and the Fin[i] in the embedded clause must not be interrupted by an intensional operator, for the indicative to be allowed. The binding of the embedded Fin[i]-s is required for this to follow.

The account generalizes to other indefinite relatives. Farkas (1985) offered a detailed discussion of the subjunctive in Romanian relative clauses in indefinite DPs, which she extended to French and Italian. (See Quer, 2001 for an account in terms of a notion of *model shift* that converges with her generalizations.) According to Farkas, intensional contexts generally require the subjunctive in indefinite relatives in their scope, as in (48); a systematic exception are intensional verbs that take indicative in their complement clause, like *say*, *dream* etc. Relative clauses in indefinite DPs below these are standardly also in the indicative, as in (49a). As shown in (49b), the current account can derive this. Indicative-taking verbs go with p-relativization in their complement, which will bind [i] in Fin[i] in a lower relative clause.

(49) a. Jean croit que quelqu'un [qui veut/*veuille le tuer] le poursuit.
'John believes that someone who wants.IND/*SBJV to kill him follows.IND him. '
b. J. believes [**Force Foc[i]** that someone follows.IND him]
[**Fin[i]** who wants.IND to kill him]

I add a remark on French adverbial clauses. While mood in them is a complex terrain, the overall situation is promising for the current account. Where the adverbial complementizer C is intensional, such as in purpose clauses, the subjunctive is the typical mood in the adverbial clause: the embedded Fin[i] can be bound from the matrix clause but the intensional C intervenes. With non-intensional C, such as in temporal clauses, indicative is normally used: [i] in Fin[i] is bound from the matrix clause, and the world variable in the temporal clause is the same as in the main clause (see e.g. Hawkins and Towell, 1996).

5. Summary

The French indicative and German V2 share the Fin-head Fin[i][+bel], here interpreted in terms of the presupposition for the French indicative by Schlenker (2006). It turns on a value for the logophoric index [i] that refers to the perspective holder.

Regarding the connection of [i] to the relevant perspectival meaning components of a higher clause, a mechanism of *p-relativization* is argued for, adapted from a suggestion of Heim (2005): Movement of Fin[i] to Force creates a perspectival relative clause structure with Force[i] as the operator and Fin[i] as the variable. The external head of this perspectival relative clause structure is either the anchor of the matrix verb (in complement clauses, restricting the matrix verbs) or the higher abstract element ASS (in unembedded clauses).

French optionally allows p-relativization. Each [i] in a Fin[i][+bel] that locally licenses indicative in its clause needs a value. It can get that either by undergoing p-relativization (in complement position or unembedded under ASS), or by being bound by a higher instance of p-relativization (in embedded adjunct clauses). It was seen that this leads to an account of the distribution of indicative vs. subjunctive relative clauses in indefinite DPs by Farkas (1985), and that this account supports the binding analysis.

German verbal mood morphology is additionally specified for [±origo]. In V2-clauses, this triggers movement of the finite verb to Force, where [±origo] is interpreted. The movement takes along [i] from Fin[i]. Therefore p-relativization is an inherent part of German V2-clauses. This eliminates the option that [i] gets a value by being bound. In adjunct V2 clauses, ASS is then required as a local antecedent of p-relativization, restricting the occurrence of adjunct V2-clauses. The account is an argument for the mechanism of p-relativization.

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Generic Sentences: Representativeness or causality?

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Abstract. Many generic sentences express stable inductive generalizations. Stable inductive generalizations are typically true for a causal reason. In this paper we investigate to what extent this is also the case for the generalizations expressed by generic sentences. More in particular, we discuss the possibility that many generic sentences of the form '*k*s have feature *e*' are true because (members of) kind *k* have the causal power to 'produce' feature *e*. We will argue that such an analysis is quite close to a probabilistic based analysis of generic sentences according to which 'relatively many' *k*s have feature *e*, and that, in fact, this latter type of analysis can be 'grounded' in terms of causal powers. We will argue, moreover, that the causal power analysis is sometimes preferred to a correlation-based analysis, because it takes the causal structure that gives rise to the probabilistic data into account. Unfortunately, there are problems for the causal power analysis too, and we will discuss them as well.

Keywords: Generic sentences, causality, probability.

1. Introduction

The proposal that we will discuss in this paper is that many generic statements, like (1a)-(1c) should be given a causal analysis.

(1) a. Tigers are striped.
 b. Birds fly.
 c. Birds lay eggs.

This paper is structured as follows: in the following section we will briefly motivate a recently proposed frequency-based descriptive analysis according to which a generic sentence of the form '*k*s are *e*' express inductive generalizations. In this section we will also discuss a conceptual problem for this frequency-based analysis: the fact that the analysis seems too extensional. In section 3 we will provide a causal explanation for the descriptive analysis making use of some natural independence assumptions, and thereby solving the above mentioned conceptual problem that the frequency-based analysis of section 2 is too extensional. In section 4 we will show that once the independence assumptions of our causal derivation are given up, a causal analysis will, perhaps, give rise to improved empirical predictions. We will argue that giving up these assumptions is sometimes very natural. In section 5 we will discuss another important distinction between a purely probabilistic account, and the causal one suggested in this paper: the resulting asymmetry due to causality and the need for an additional evidential reading. Section 6 concludes the paper.

2. A probabilistic analysis of generics and its problems

Generic sentences come in very different sorts. Consider (2a), (2b) and (2c).

(2) a. Tigers are striped.
 b. Mosquitoes carry the West Nile virus.
 c. Wolves attack people.

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We take (2a) to be true, because the vast majority of tigers have stripes. But we take (2b) and (2c) to be true as well, even though less than 1% of mosquitoes carry the virus and the vast majority of wolves never attack people. Most accounts of generics, if they don't stipulate an ambiguity, start from examples like (2a) and then try to develop a convincing story for examples like (2b) and (2c) from here. In our previous analysis (van Rooij and Schulz, to appear), in contrast, we took examples like (2b) and (2c) as points of departure and then generalized the analysis to account for more standard examples as well, in the hope that it would lead to a more uniform analysis.

What is the natural analysis of examples like (2b)? We take this to be that:

1. it is **typical** for mosquitoes that they carry the West Nile virus, and
2. this is highly relevant information, because of the **impact** of being bitten by a mosquito when it carries the West Nile virus.

We take it that it is intuitively quite clear when one feature has a significantly higher **impact** than another. This is normally the case when the first feature gives rise to a more negative emotional reaction than the latter. We realize, however, that from here to come up from a quantitative measure of 'impact' is a long way to go, and we have not much to offer.[1]

As for **typicality**, it is obviously not required for e to be a typical feature for ks that *all* ks have feature e. Although almost all tigers are striped, there exist albino tigers as well, which are not striped. And although '(be able to) fly' is a typical feature for birds, we all know that penguins don't have this feature. The same examples show that e can be typical for k although not only ks have feature e: cow and cats, too, can be striped, and bats fly as well. So we need a weaker notion of typicality. We take it that *distinctiveness* matters for typicality, and thus for generics. This can be illustrated by the contrast between (3a), which is intuitively true, versus (3b), which is false.

(3) a. Lions have manes.
b. *Lions are male.

One might think that (3b) is false because only 50%, if at all, of the lions are male, which cannot be enough for a generic to be true. But that, clearly, cannot be the reason: the only lions that have manes are male lions. Thus, not even 50% of the lions have manes. Still, (3a) is, intuitively, true. The conclusion seems obvious: (3b) is true, because it is *distinctive* for lions to have manes, where the notion of distinctiveness shouldn't be too strong. On a weaker analysis of 'being distinctive', one demands only that *in comparison with* other larger animals, many males have manes. Similarly, for (2b) to be true it is at least required that compared to other insects, many mosquitoes carry the West Nile virus. To account for this comparative analysis, one could make use of either a qualitative or a quantitative analysis. But because we want to incorporate the importance of the second condition, *impact*, within an analysis of 'relatively many', it is almost mandatory to provide a *quantitive* analysis of distinctiveness.[2,3] If typicality

[1]However, we do have one suggestion: looking at news items. What is typically being reported in news items are things or events that we feel have a big impact, even if they are rather uncommon.

[2]Of course, these considerations are well-known to users of decision- and game theory. who have to combine uncertainty with utility.

[3]This argument won't have any force if one takes generic sentences to be *ambiguous* between majority-generics

reduces to distinctiveness and if we have such a quantitative analysis of distinctiveness, plus a quantitative measure of impact, we can define a measure of a generic sentence of the form 'ks are e' as distinctiveness of e from k, $Distinctiveness(e,k)$, $\times$ $Impact(e)$. We could call this measure the *representativeness* of e for k. Because we will argue later that typicality cannot always be reduced to distinctiveness, the representativeness of e for k, $Repr(e,k)$, should be defined more generally as

- $Repr(e,k) \quad =_{df} \quad Typicality(e,k) \times Impact(e)$.

Then we can say that the generic sentence 'ks are e' is true, or appropriate, if and only if the *representativeness* of e for k, $Repr(e,k)$, is high:

- 'ks are e' is true if and only if $Repr(e,k)$ is high.

Before we concentrate on the more general notion of typicality, let us first discuss various potential measures of distinctiveness. To provide a quantitative analysis of what it means that feature e is distinctive for group k, i.e., that relatively many ks have feature e, there are many options open. On one natural analysis, it holds that relatively many ks have feature e if and only if the relative frequency of ks that are e is higher than the relative frequency of alternatives of k that are e. If we measure relative frequency by probability function P, this can be captured by the condition that $P(e|k)$– i.e., the conditional probability of having feature e given that one is a member of group or kind k–is higher than $P(e|\bigcup Alt(k))$, where $Alt(k)$ denotes the (contextually given) alternatives to group k, and $\bigcup Alt(k)$ thus denotes the set of members of any of those alternatives. For readability, we will from now on abbreviate $\bigcup Alt(k)$ by $\neg k$. Thus, relatively many ks are e iff $P(e|k) - P(e|\neg k) > 0$. In psychology, the measure $P(e|k) - P(e|\neg k)$ is called 'contingency' and denoted by ΔP^e_k. This notion plays an important role in the theory of associative learning (cf. Schanks, 1995), and it is well-known that $\Delta P^e_k > 0$ if and only if $P(e|k) > P(e)$, the standard notion of *relevance*.[4] It should be noted, however, that $P(e|k) - P(e|\neg k)$ does not behave monotone increasing with respect to $P(e|k) - P(e)$.[5] So the choice between these two measures makes a difference for predictions. Notice that if we use contingency to model distinctiveness, and if also typicality reduces to it, it is predicted that the generic 'ks are e' is true, or acceptable, if and only if $[P(e|k) - P(e|\neg k)] \times Impact(e)$ is high. This, in turn, is high iff $P(e|k) \times Impact(e) >> P(e|\neg k) \times Impact(e)$, if '$>>$' means 'highly above'. If we abbreviate $P(e|k) \times Impact(e)$ by $EV(e|k)$, the expected value of e given k, this means that the generic 'ks are e' is true, or acceptable, iff $EV(e|k) >> EV(e|\neg k)$. If we use standard relevance, the generic would be true iff $EV(e|k) >> EV(e)$. For features with $Impact(e) = 1$, these two equalities hold iff $P(e|k) >> P(e|\neg k)$ and $P(e|k) >> P(e)$, respectively, meaning that a small difference between $P(e|k)$ and $P(e|\neg k)$ (or $P(e)$) is not enough to make the generic true.

Although contingency is a natural measure to determine 'distinctiveness', in van Rooij and Schulz (to appear) we proposed that it should be measured by a slight variant of Shep's (1958)

like (2a), on the one hand, and 'striking' generics like (2b) and (2c), on the other. In fact, Leslie (2008) proposed such an 'ambiguity'-analysis. But we don't see any empirical evidence in favor of such an ambiguity analysis, and we thus take it to be obvious that a uniform analysis is preferred. We will see that what Leslie calls 'majority'-generics fall out as a special case of our uniform analysis.

[4]Cohen (1999) proposed that a generic sentence of form 'ks are e' is true on its relative reading iff $P(e|k) > P(e)$, if we limit the 'domain' of the probability function to $k \cup \bigcup Alt(k)$.

[5]In fact, $P(e|k) - P(e) = P(\neg k) \times [P(e|k) - P(e|\neg k)]$.

notion of 'relative difference', $\Delta^{**}P^e_k = \frac{\alpha P(e|k)-(1-\alpha)P(e|\neg k)}{\alpha-(1-\alpha)P(e|\neg k)}$, with $\alpha = \frac{P(k)}{P(k)+P(\neg k)}$. Notice that in case $P(k) = \frac{1}{2}$, it will also be the case that $\alpha = \frac{1}{2}$ and that $\Delta^{**}P^e_k$ comes down to Shep's notion $\Delta^{*}P^e_k = \frac{P(e|k)-P(e|\neg k)}{1-P(e|\neg k)}$, while in case $P(\neg k) = 0$—i.e. when $\bigcup Alt(k) = \emptyset$—$\alpha$ ends up being 1 and $\Delta^{**}P^e_k$ comes down to $P(e|k)$. We will assume that the tokens of the alternative kinds are chosen such that $P(\bigcup Alt(k)) = P(\neg k) = P(k)$, in case $Alt(k) \neq \emptyset$. Thus, $\alpha \in \{\frac{1}{2}, 1\}$. In sum:

- $Typicality(e,k) \quad =_{df} \quad \frac{\alpha P(e|k)-(1-\alpha)P(e|\neg k)}{\alpha-(1-\alpha)P(e|\neg k)} \quad = \quad \Delta^{**}P^e_k$ with $\alpha = \frac{P(k)}{P(k)+P(\neg k)}$.

Three arguments were given for this choice:

(i) Suppose that the vast majority of members of $\bigcup Alt(k)$ are of kind k' and that $P(e|k')$ is slightly higher than $P(e|k)$. If we don't control for the number of tokens of alternative kinds, or types, we take into account, 'ks are e' will be predicted to be false, even if for most $k'' \in Alt(k)$ $P(e|k) >> P(e|k'')$. But that seems wrong. One way to predict correctly would be to count not *all tokens* of the alternatives types, but rather equally many tokens of each alternative type such that we look at as many tokens if we look at the tokens of all these types together as there are tokens of k. Thus, it is important that we control for the number of tokens of alternative kinds, and the demand that $P(\bigcup Alt(k)) = P(\neg k) = P(k)$ is a special case of this.

(ii) in case $P(e|k) = 1$ and $P(e|\neg k) \neq 1$, the generic sentence seems to be perfect, whatever the value of $P(e|\neg k)$ is. In contrast to the standard notion of relevance, this comes out by using our measure of typicality for both values of α.

(iii) in case e is an uncommon feature, i.e, when $P(e|\neg k)$, or $P(e)$, is low, the difference between $P(e|k)$ and $P(e|\neg k)$—$P(e|k) - P(e|\neg k)$—should be larger for the generic to be true or appropriate than when $P(e|\neg k)$ is high, if $\alpha = \frac{1}{2}$.[6]

From (ii) and (iii) it follows that for distinctiveness of e for k, the conditional probability of e given k, $P(e|k)$, counts for more than $P(e|\neg k)$. And this seems required. Consider, on the one hand, the uncommon feature 'having 3 legs'. Although there are (presumably) relatively more dogs with three legs than there are other animals with three legs, this doesn't mean that the generic 'Dogs have three legs' is true (cf. Leslie, 2008). If a more common feature is used, on the other hand, an equally small difference between $P(e|k)$ and $P(e|\neg k)$ can make the difference between truth and falsity of the generic sentence, if the generic is used to contrast k from other kinds.

In summary, the following analysis of generic sentences of the form 'ks are e' was proposed:

- 'ks are e' is true if and only if $Repr(e,k)$ is high.
- $Repr(e,k) \quad =_{df} \quad \Delta^{**}P^e_k \times Impact(e)$.
- $\Delta^{**}P^e_k \quad =_{df} \quad \frac{\alpha P(e|k)-(1-\alpha)P(e|\neg k)}{\alpha-(1-\alpha)P(e|\neg k)}$ with $\alpha = \frac{P(k)}{P(k)+P(\neg k)}$.

It should be clear how examples like (2a)-(2c) can be accounted for on this proposal: (2a) is true, or appropriate, because being striped is distinctive for tigers, whereas (2b) is true because (i) more mosquitos than other types of insects carry the West Nile virus, and (ii) carrying this

[6] For instance, in case $P(e|\neg k) = 0.9$, the value of $\frac{P(e|k)-P(e|\neg k)}{1-P(e|\neg k)}$ is $10 \times [P(e|k) - P(e|\neg k)]$, while if $P(e|\neg k) \approx 0$, the value of $\frac{P(e|k)-P(e|\neg k)}{1-P(e|\neg k)}$ is just $P(e|k) - P(e|\neg k)$, so 10 times smaller.

dangerous virus has a high impact. In van Rooij and Schulz (to appear) it is argued that a wide variety of generics can be accounted for using the above analysis, especially if (i) we make use of the context-dependence of which alternatives are relevant, and (ii) we assume that it is not just relative frequency that counts, but rather *stable* relative frequencies: it is not only that the measure $P(e|k) - P(e|\neg k)$ should be high, but this measure should remain high when conditioned on relevant backgrounds.[7] Moreover, in van Rooij and Schulz (to appear) it is argued that a high value of $Repr(e,k)$ gives rise —partly due to Tverksy & Kahneman's Heuristics and Biases approach — to the (perhaps false) impression that $P(e|k)$ is high, thereby accounting for the general intuition that generics like 'ks are e' are true just in case $P(e|k)$ is high. This is not the place to defend this view, and the bulk part of this paper is written on the (hypothetical?) idea that the above analysis of generics is accepted to be roughly correct.

One obvious objection to the above descriptive analysis in terms of (stable) frequencies should be mentioned, though: $\Delta^{**}P_k^e$ by itself cannot account for the 'intensional component' of generic sentences showing in their 'non-accidental' understanding. Even if actually (by chance) all ten children of Mr. X are girls, the generic 'Children of Mr. X are girls' still seems false or inappropriate.[8] The sentence only seems appropriate if being a child of Mr. X somehow *explains why* one is a girl. In this paper we will explore to what extent we can explain the meaning of generic sentences in terms of *inherent dispositions* or *causal powers*. Even though such dispositions were philosophically suspect in much of the 20th century, we take such an exploration as a worthwhile enterprise, because it seems to be in accordance with many people's intuition. Moreover, by adopting a causal stance, the non-accidental understanding of generics can, arguably, be explained as well.

3. Causal readings of generics

3.1. Causal explanation of correlations

The theory of generics in terms of the measure $\Delta^{**}P_k^e$ is very Humean, built on frequency data and probabilistic dependencies and the way we learn from those. Many linguists and philosophers feel that there must be something more: something hidden underlying these actual dependencies that **explains** them. A most natural explanation is a **causal** one: the probabilistic dependencies exists *in virtue of* objective kinds which have causal powers, capacities or dispositions.[9] Indeed, traditionally philosophers have assumed that the natural world is objectively divided into kinds, which have essences, a view that has gained popularity in the 20th century again due to the work of Kripke and Putnam. A closely associated modern view that has gained popularity recently has it that causal powers (Harre and Madden, 1975), capacities (Cartwright, 1989) or dispositions (Shoemaker, 1980; Bird, 2007) are the truth-makers of laws

[7]The notion of stability is required to think of $P(e|k) - P(e|\neg k)$ as helping to account for inductive generalizations, and does the work that Cohen (1999) argues his condition of 'homogeneity' should do. It is by concentrating ourselves on probabilities that are *stable* under conditionalization by various conditions that generics like 'Bees are sterile', 'Israeli live along the coast' and 'People are over three years old' are predicted to be bad, or false, although in each case the majority of the 'kind' has the relevant feature. For an analysis of stability that we favor, see Skyrms (1980).

[8]To account for such cases, the 'unbounded' character of generics, Cohen (1999) makes use of limiting relative frequencies. The solution we will propose in the following sections will be different, but based on a similar intuition.

[9]It seems no accident that (general) causal statements typically are of generic form: 'Sparks cause fires', 'Asbestos causes cancer'.

and other generalities.[10] Tversky and Kahneman's (1980) observed experimentally that the idea is natural: ordinary people are inclined to a causal interpretation of correlations.

While probabilistic (in)dependencies are symmetric, causal relations are not. But neither are generic sentences. Such sentences of the form 'ks are e' are, by their very nature, stated in an asymmetric way: first the noun k, then feature e. This naturally gives rise to the expectation that objects of type k are associated with features of type e because the former has the power to cause the latter. Where the goal of van Rooij and Schulz (to appear) was to develop a semantic analysis of generic sentences that is descriptively adequate, the goal of this paper is to investigate to what extent this theory can be explained by basing it on an analysis of (perhaps unobservable) causal powers. In a sense, the answer to this question is quite clear: Shep's notion of relative difference closely corresponds to Good's (1961) measure of 'causal support': $\log \frac{P(\neg e|\neg k)}{P(\neg e|k)}$. In fact, Good's notion is ordinal equivalent to Shep's notion in the sense that $\Delta^* P^e_k > \Delta^* P^{e^*}_{k^*}$ iff $\log \frac{P(\neg e|\neg k)}{P(\neg e|k)} > \log \frac{P(\neg e^*|\neg k^*)}{P(\neg e^*|k^*)}$ for all e, e^*, k and k^*. This is very interesting. In the end, though, also Good's notion is just a frequency measure. What we would like to find is a 'deeper' foundation of our measure. In a sense, this is what Good provides as well, for he provides an axiomatization of his notion of causal support. But we think that the causal foundation that we will give is more natural, and fundamental.

We don't want to claim that a causal analysis can account for all types of generics. Generics like 'People born in 1990 reach the age of 40 in the year 2030' and 'Bishops move diagonally' (in chess) are most naturally not treated in a causal way. Linguists (Lawler, 1973; Greenberg, 2003) also make a difference between generics formulated in terms of bare plurals (BP) ('Dogs bark'), on the one hand, and generics stated in terms of indefinite singular (IS) noun phrases ('A dog barks'), and found that IS generics have a more limited felicity, and suggested that in contrast to a BP generic, for an IS generic to be felicitous, there has to exist a 'principle connection' between subject noun and predicate attributed to it. Perhaps this means that only IS generics should be given a causal analysis. Perhaps. But we do think that for many, if not most, BP generics causality could play an important role as well. The purpose of this paper is not to defend the strong view that all generics should be analyzed causally. Instead, our purpose is more modest: to explore the possibility of a causal power analysis of BP generics.[11]

As part of this, we want to to clarify what, if any, advantage(s) such a causal power analysis might provide. These advantages could be of a conceptual and an empirical nature. As for the former, if all that is gained by a causal analysis of e.g., 'Aspirin relieves headaches' is that the observed frequency of relieved headaches is said to be due to the Aspirins unobservable capacity to relieve headache, nothing is won. For a causal analysis to be useful more insights should be gained, for instance in the internal structure of the cause. But a causal analysis will be useful here as well, as shown by the recent abundance of papers on *mediation* (Preacher and Kelley, 2011; Pearl, 2014): the use of causal models to explain not only *why* something happened, but also *how* it happened. Scientists are not only interested to learn *that* Aspirin relieves headaches, they are also interested in the *mechanism* by which it does so. In this paper we will make use of the recent insights of causal mediation analyses that make a difference between *direct* and *indirect* causal effects. In the next section we will show that under certain circum-

[10] According to Strawson (1989), even Hume himself believed in causal powers.
[11] We leave a discussion of IS generics to another paper.

stances a causal interpretation gives rise to different, and arguably *more adequate predictions* than an extensional theory making use of $\Delta^{**}P_k^e$, especially if we concentrate on *direct* effects. But first we will show in this section that under natural assumptions a causal analysis *explains* the predictions made by using $\Delta^{**}P_k^e$.

3.2. A causal derivation of $\Delta^{**}P_k^e$

For our causal explanation of the measure $\Delta^{**}P_k^e$ we follow Cheng (1997) and assume that objects of type k have unobservable **causal powers** to produce features of type e. We will denote this unobservable causal power by p_{ke}. It is the probability with which k produces e when k is present in the absence of any alternative cause. This is different from $P(e|k)$. The latter is the relative frequency of e in the presence of k. We will denote by u the (unobserved) alternative potential cause of e (or perhaps the union of alternative potential causes of e), and by p_{ue} and $P(e|u)$ the causal power of u to produce e and the conditional probability of e given u, respectively. We will assume (i) that e does not occur without a cause and that k and u are the only potential causes of e (or better that u is the union of all other potential causes of e other than k), (ii) that p_{ke} is independent of p_{ue}, and (iii) that p_{ke} and p_{ue} are independent of $P(k)$ and $P(u)$, respectively, where independence of p_{ke} on $P(k)$ means that the probability that k occurs and produces e is the same as $P(k) \times p_{ke}$. The latter independence assumptions are crucial: by making them we can explain the *stability* and (relative) context-independence of generic statements.

Now we are going to derive p_{ke}, the causal power of k to produce e, following Cheng (1997).[12] To do so, we will first define $P(e)$ assuming that e does not occur without a cause and that there are only two potential causes, k and u (recall that $P(k \vee u) = P(k) + P(u) - P(k \wedge u)$):

(4) $$P(e) \quad = \quad P(k) \times p_{ke} + P(u) \times p_{ue} - P(k \wedge u) \times p_{ke} \times p_{ue}.$$

Thus, the probability that e, conditional on k and $\neg u$ is

(5) $P(e|k, \neg u) \quad = \quad p_{ke} \quad = \quad$ **the causal power of k to generate e.**

Because the probability that e given k in the absence of all other causes u does not depend on the frequency of these other causes, it does not depend on the base rate of e. As such it can be thought of as an inherent property of k, and can be extrapolated across contexts in which base rates differ.

One problem with this notion is that it depends on u, which is unobservable, or many times cannot be identified. Thus, it still remains unclear how to estimate the causal power of k to produce e. It turns out that things are clearer if we *assume that k and u are, or are believed to be, independent of each other*. Assuming independence of k and u, $P(e)$ becomes

(6) $$P(e) \quad = \quad P(k) \times p_{ke} + P(u) \times p_{ue} - P(k) \times P(u) \times p_{ke} \times p_{ue}.$$

As in section 2, ΔP_k^e is going to be defined in terms of conditional probabilities:

(7) $$\Delta P_k^e \quad = \quad P(e|k) - P(e|\neg k).$$

[12] Glymour (2001) calls Cheng's derivation 'a brilliant piece of mathematical metaphysics'. Cheng (1997) also discusses an analysis of *preventive* causes. We won't deal with this in this paper.

The relevant conditional probabilities are now derived as follows:

(8) $P(e|k) = p_{ke} + (P(u|k) \times p_{ue}) - p_{ke} \times P(u|k) \times p_{ue}.$
$P(e|\neg k) = P(u|\neg k) \times p_{ue}$ (derived from (4), because $P(k|\neg k) = 0$).

As a result, ΔP_k^e comes down to

(9) $$\begin{aligned}\Delta P_k^e &= p_{ke} + (P(u|k) \times p_{ue}) - (p_{ke} \times P(u|k) \times p_{ue}) - (P(u|\neg k) \times p_{ue}) \\ &= [1 - (P(u|k) \times p_{ue})] \times p_{ke} + [P(u|k) - P(u|\neg k)] \times p_{ue}.\end{aligned}$$

From this last formula we can derive p_{ke} as follows:

(10) $$p_{ke} = \frac{\Delta P_k^e - [P(u|k) - P(u|\neg k)] \times p_{ue}}{1 - P(u|k) \times p_{ue}}.$$

From (10) we can see that ΔP_k^e gives a good approximation of causal power in case (i) u is independent of k (meaning that $P(u|k) - P(u|\neg k) = 0$), and (ii) $p_{ue} \times P(u|k)$ is low. Obviously, in case k is the only potential direct cause of e, i.e., when $p_{ue} = 0$, it holds that $p_{ke} = \Delta P_k^e$. Because in those cases $P(e|\neg k) = 0$, it even follows that $p_{ke} = P(e|k)$.

Our above derivation shows that to determine p_{ke} in case events or features of type e might have more causes, we have to know the causal power of p_{ue}, which is equally unobservable as p_{ke}. You might wonder what we have learned from the above derivation for such circumstances. It turns out, however, that p_{ke} can be estimated in terms of observable frequencies after all, because we assumed that $P(k)$ and $P(u)$ are independent of each other. On this assumption it follows that $P(u|k) = P(u) = P(u|\neg k)$ and that (10) comes down to

(11) $$p_{ke} = \frac{\Delta P_k^e}{1 - P(u|k) \times p_{ue}}.$$

Because of our latter independence assumption, it follows as well that $P(u|k) \times p_{ue} = P(u) \times p_{ue} = P(e|\neg k)$. This is because $P(u) \times p_{ue}$ is the probability that e occurs and is produced by u. Now, $P(e|\neg k)$ estimates $P(u) \times p_{ue}$ because k occurs independently of u, and, in the absence of k, only u produces e. It follows that p_{ke} can be defined in terms of observable frequencies as follows:

(12) $$p_{ke} = \frac{\Delta P_k^e}{1 - P(e|\neg k)}.$$

But this is exactly the same as $\Delta^* P_k^e$, the measure in terms of which we have stated the truth conditions of generic sentences in section 2! Thus, in case we assume that a generic sentence of the form 'Objects of type k have feature e' is true because objects of type k cause, or produce, features of type e, we derive exactly the semantics we have proposed in the first place (if $\alpha = \frac{1}{2}$). It follows that as far as our descriptive analysis of generics in terms of $\Delta^* P_k^e$ was correct, what we have provided in this section is a **causal explanation**, or grounding, of this descriptive analysis.

The above derivation causally motivated Shep's notion of 'relative difference'. But that notion is a special case of $\Delta^{**} P_k^e$ in case $\alpha = \frac{1}{2}$. We have seen above that in case $\alpha = 1$, what should come out is that $\Delta^{**} P_k^e$ comes down to $P(e|k)$. Does a causal analysis motivate this as well? It does! We have seen in section 2 that $\alpha = 1$ just in case $Alt(k) = \emptyset$. In our causal derivation, this means that there is no alternative potential cause of e, i.e., that k is the *only potential cause* of e. What happens to our above derivation in that case? To see this, notice that in that case $P(e)$ can be determined as follows:

(13) $P(e) \quad = \quad P(k) \times p_{ke}.$

As a result, $P(e|k)$ reduces to p_{ke}. Thus, $p_{ke} = P(e|k)$ in case k is the only potential cause of e, just like $\Delta^{**}P^e_k$ came down to $P(e|k)$ in case $Alt(k) = \emptyset$. Thus, our earlier measure $\Delta^{**}P^e_k$ could be motived by our causal powers view both when $\alpha = \frac{1}{2}$ and when $\alpha = 1$.

How do these causal powers account for generic sentences? This is easiest to see for generics involving homogenous substances, like 'Sugar dissolves in water' and 'Metal conducts electricity'. Intuitively, these are true, because of the causal power of sugar and metal to generate the observable manifestations that come with the relevant predicates. Similarly, 'Tigers are striped' is true, on a causal account, because of what it is to be a tiger. But sometimes the power description should be relativized. For instance, 'Ducks lay eggs' is true, although only the female chickens do so. Intuitively, it is not the causal power of 'being a duck' in general that makes this generic true. Rather, it is the causal power of being a *female* duck. But this comes out naturally. Cohen (1999) argued that the 'domain' of the probability function should be limited to individuals that make at least one of the natural alternatives of the predicate term true. In our example, it is natural to assume that $Alt(lay\ eggs) = \{Lay\ eggs, give\ birth\ live\}$. Because $\bigcup Alt(lay\ eggs) \approx Female$, this means that we should only consider female ducks. This should be done as well for the estimation of causal power. Doing so, it will be the case that the causal power of female ducks to lay eggs is high, which gives rise to the correct prediction that the generic 'Ducks lay eggs' is true. It is also clear how our analysis can account for 'striking' generics like (2b) and (2c): instead of demanding that $\Delta^{*}P^e_k \times Impact(e)$ is high, one now demands that $p_{ke} \times Impact(e)$ is high, which normally comes down to the same.

4. Giving up independence of the potential causes

In the previous section we assumed with Cheng (1997) that e had two potential causes, k and u, and that these causes were independent of each other: $P(u|k) = P(u|\neg k) = P(u)$. As noted by Glymour (2001), by adopting this assumption, Cheng assumed implicitly a specific type of causal structure: that what via Pearl (1988) is known as a 'Noisy OR-gate'.

$$
\begin{tikzcd}
K \arrow[dr, "p_{ke}"'] & & U \arrow[dl, "p_{ue}"] \\
& E &
\end{tikzcd}
$$

Thus, as noted by Glymour (2001), the models that Cheng uses to calculate how we can estimate causal powers are in fact special cases of structural causal models as developed by Pearl (2000) and Spirtes et al. (2000).[13] In general, the potential causes of a variable don't have to

[13]These models, in turn, are also generalizations of structural analyses used in biology, genetics and epidemiology. The standard structural models in these social sciences are *linear models*, models which consists of a system of linear equations. In such a linear equation, the relationship between two variables, X and Y, can be given by something like $Y = \alpha + \beta X + \varepsilon$, where α and β are constants, ε an error term, and Y and X the dependent and independent variable, respectively. Although the values of α and β (the path coefficient) can be determined by standard regression analysis, what is special about the structural interpretation of such linear models is that X is seen as a *cause* of Y: a change of the value of X causes a change of the value of Y, and not the other way around.

be independent of each other. It could be, for instance, that values of (variables) K and U both have causal influence on the value of E, but that K also has a causal influence on U, or the other way around. It could also be, of course, that there is a common cause of K and U.

We will see below (with Glymour, 2001)[14] that also in such situations, the causal power of X to influence Y can sometimes be estimated from frequency data, at least if we keep in mind the causal structure that generated these data.

If independence is only a useful, but sometimes incorrect, heuristics to determine probabilities, it raises the question what happens if we give up this independence assumption? Quantitatively speaking, there are two possibilities: $P(u|k) > P(u|\neg k)$ and $P(u|k) < P(u|\neg k)$. Already by looking at the general definition of p_{ke}:

(14) $$p_{ke} \quad = \quad \frac{\Delta P^e_k - [P(u|k) - P(u|\neg k)] \times p_{ue}}{1 - P(u|k) \times p_{ue}},$$

we can immediately observe the following:

1. If $P(u|k) < P(u|\neg k)$, then $\Delta^* P^e_k$ **underestimates** p_{ke}.
2. If $P(u|k) > P(u|\neg k)$, then $\Delta^* P^e_k$ **overestimates** p_{ke}.

Thus, although giving up on independence doesn't allow us anymore to determine p_{ke} in terms of observed frequencies alone (because we now also need to know $p_{ue}, P(u|k)$ and $P(\mathrm{u}|\neg k)$), giving up independence still potentially gives rise to interesting empirical consequences. In the following subsections we will look at both cases, and see that they give rise to interesting new predictions.

4.1. $\Delta^* P^e_k$ underestimates p_{ke}.

First, we will look at the most extreme case where $P(u|k) < P(u|\neg k)$, namely where u and k are **incompatible**. Notice that in that case $P(u|k) = 0$. The relevant conditional probabilities are then derived from (4) as follows: $P(e) = P(k) \times p_{ke} + P(u) \times p_{ue}$. From this we derive immediately that $P(e|k) = p_{ke}$, because $P(u|k) = 0$.

Thus, we see that in case k and u are incompatible, the causal power of k to produce e is the same as the conditional probability $P(e|k)$, just as was the case if k is the only cause of e. Perhaps this can explain the intuition people have that the acceptability of a generic sentence of the form 'ks are e' goes with its conditional probability $P(e|k)$. Thus, although under natural independence conditions $p_{ke} = \Delta^* P^e_k$, this is no longer the case once k and u are not taken to be probabilistically independent.

On this interpretation, the value of β carries causal information. The causal models of Pearl and Spirtes et all. are a generalization of the above, because for them the equations don't have to be of linear form.

[14] Pearl (2000) has an alternative derivation of $\Delta^* P^e_k$, what he calls 'the probability of causal sufficiency', PS. Pearl derives PS — our $\Delta^* P^e_k$ — from the measure $P(e_k|\neg k, \neg e)$, the probability of e after intervention with k when you are in a state where k and e are false. In this derivation Pearl doesn't use the assumption that there is a statistically independent alternative cause, u, that may produce e. He substitutes this assumption with an assumption of monotonicity: that k never prevents e. Pearl doesn't make use of causal powers in the derivation of $\Delta^* P^e_k$, but uses an assumption of causality, or intervention, as primitive instead. One can think of Pearl's PS as a generalization of Cheng's causal power as well, because applicable in more situations than Cheng's notion.

Are there good examples of generic statements where k and u (the union of alternative causes of feature e) are incompatible, or where k is taken to be the only cause of e? This depends very much on what one takes the alternative causes to be. Take any generic of the form 'ks are e'. Let us assume that $P(e|k)$ is high. We have argued in section 2 that this is not always enough to make the generic true. But now suppose that 'k' denotes a kind of animal (e.g., 'horse') and that e is a feature like 'having a heart'. If one makes the Aristotelian assumption that x is a member of a kind if and only if x has the *essence* of that kind, then it is natural that we take the alternative causes of (having feature) e to be (essences of) other kinds of animals. Thus, $u = \bigcup Alt(k)$, with k incompatible with u. If for the analysis of generics we adopt the measure $\Delta^* P^e_k$ (with k denoting horses and e denoting creatures with a heart), the generic 'Horses have a heart' is most likely counted as false, simply because $P(e|k) = P(e|\neg k) = P(e|\bigcup Alt(k))$, and thus $P(e|k) - P(e|\neg k) = 0$, meaning that also $\Delta^* P^e_k = 0 = \Delta^* P^e_k$, if $\alpha = \frac{1}{2}$. Thus, on a correlation-based analysis, the generic is predicted to be false if $\alpha = \frac{1}{2}$.[15] On a causal power view, however, the sentence is predicted to be true, because now $p_{ke} = P(e|k) \approx 1$. Of course, that $p_{ke} = P(e|k)$ was due to the assumption that k and u (the union of alternative causes of feature e) are incompatible. Perhaps this view only makes sense once one makes the highly controversial Aristotelian assumption that it is the essences of kinds that have causal powers. But controversial as this assumption might be, psychologists like (Keil, 1989; Gelman, 2003) and others have argued that both children and adults tend to have essentialist beliefs about a substantial number of categories.[16]

4.2. $\Delta^* P^e_k$ overestimates p_{ke}.

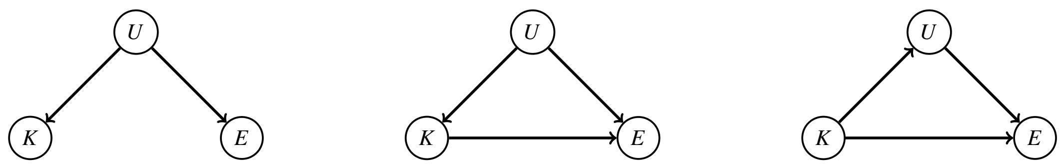
An analysis of generic sentences of the form 'ks are e' in terms of causal powers is perhaps most natural when k denotes a *homogenous natural kind*. The reason is that if two objects are of the same homogenous natural kind, they are very *similar*. It is this similarity that allows us to *inductively infer* unobservable features of this object of natural kind k from observed features of other objects of natural kind k. But this inductive inference crucially relies on a close similarity between the members of natural kind k. For natural or artificial kinds, or groups, that allow for a larger variation, an analysis in terms of causal powers might seem, perhaps, less natural. We want to argue that a causal analysis might be insightful, after all. The reason is that a causal analysis can take into account the causal structure *behind* the observed frequencies, and can make a distinction between *direct* and *indirect* causal powers, and effects.

If u, like k, is a generative cause of e, p_{ke} will be lower than $\Delta^* P^e_k$ in the following three causal

[15] Of course, $\Delta^{**} P^e_k$ comes down to $P(e|k)$ if $\alpha = 1$.

[16] Danks (2014) represents concepts as graphical-model-based probability distributions (see also Sloman, 2005). He shows that all the most prominent models of concepts (the theory-based, the prototype-based, and the exemplar-based) can be modeled by such distributions. An exemplar-based model of a concept, for instance, according to which the connection between an individual d and a concept C should be based on the similarity between d and each of the exemplars of C, can be represented by a probability function over features, such that every pair of features are associated with one another, but that these associations are all due to an *unobserved common cause*. (Danks (2014) shows how to directly translate in both directions between an exemplar-based concepts (making use of similarities between the members) and a graphical-based probability function with a common cause structure. Arguably, this is just as well the correct representation of a probabilistic version of a more traditional essence-based model of concepts, with the essence, or substantial form, as the unobserved, or latent, variable.

structures,[17] because in these structures u is a confounding factor to determine the causal influence of k on e in terms of conditional probabilities:



To see potential empirical advantages of the causal power account, we should have examples with the above causal structures that are predicted to be true or acceptable on the probabilistic measure $\Delta^* P_k^e$, but false on the causal measure p_{ke}. We are not sure whether such examples exist for standard BP generics, but we will discuss some cases, leaving it to the reader (and perhaps future empirical research) to have a more definite opinion.

A well-known example of structure (i) involves yellow fingers (k) and lung cancer (e). It used to be the case that cigarettes had filters that caused smokers to get yellow fingers. We know by now that smoking also causes lung cancer. It follows that many people that have yellow fingers get lung cancer, and thus that $\Delta^* P_k^e$ (and $P(e|k)$) is high. But, obviously, getting lung cancer is not due to having yellow fingers, i.e., in this causal structure $p_{ke} = 0$. It is smoking (u) that causes both. The question is whether the following generic is nevertheless true:

(15) People with yellow fingers develop lung cancer.

If the answer to this question is negative, (15) is false, although $\Delta^* P_k^e$ and $P(e|k)$ are high. If so, this example shows an empirical advantage of the causal account.

Examples of type (i) are easy to analyze (though see section 5), because there is no causal relation at all between k and e. Causal structures (ii) and (iii) are different in this respect. Still, it will be the case in these structures that p_{ke} is low while $\Delta^* P_k^e$ is high, in case p_{ke} is low and $P(u|k)$ and p_{ue} are high. There are many examples like that. Suppose, for instance, that women drink significantly more tea on a regular basis than men and that it is somewhat better to drink tea than to drink, say, coffee. In many countries it is also the case that women have a higher life expectancy than the average life expectancy. Thus, there will be a positive correlation between 'drinking tea' and 'higher than average life expectancy'. We wonder, however, whether this by itself makes the following generic true.

(16) People that drink tea regularly have a higher than average life expectancy.

If this generic is taken to be false, we take it that this is due to the fact that the direct causal effect of drinking tea on life expectancy is just small.

In section 4.2.1 we saw that in causal structures of the form (iii), there exists a difference between the *direct* power of k to cause e, $p_{ke}^{direct} = P(e_{\neg u}|k)$, and the *total* power to do so, $p_{ke}^{total} = p_{ku} \times p_{ue} + p_{ke}^{direct}$. It is natural to define for such cases a third measure of causal

[17] To be sure, there are many more complicated causal structures with various variables where this will be the case. To focus discussion, however, we look only at these simple cases.

power as well: *indirect* causal power: $p_{ke}^{indirect} = p_{ku} \times p_{ue}$. We hypothesize that these different measures are relevant for the analysis of generic sentences. More in particular, we think it is natural that we take generics of the form 'k are e' to be true if and only if p_{ke}^{direct} is high, at least if it is natural that both $p_{ke}^{direct} > 0$ and $p_{ke}^{indirect} > 0$, as in figure (iii).[18] Consider generic sentences like:

(17) a. Jews are capitalists.
b. Jews are communists.

It is true (or let us assume so) that relatively many Jews in Germany in the first half of the 20th century were working in the financial sector (and thus are capitalists). It is also true (or let us assume so) that relatively many Jews were (famous) communists during this period. So, according to the associative analysis discussed in section 2, these generic sentences are predicted to be true in that period (under our assumptions). Although the Nazi regime used both types of generics in their propaganda against the Jews (cf. O'Shaughnessy, 2016), it is now almost universally agreed that both sentences are (and were) false. The reason is, or so it seems, that the fact that relatively many Jews were working in the financial sector, or became communists, was *not directly* due to these people being Jewish. Instead, the reason was *indirect*: relatively many Jews were working in the financial sector (in Europe), for instance, because in contrast to the Jews, the catholic majorities in these countries were not allowed to loan money for a profit, although the need to borrow money was there. Moreover, the Jews were forbidden to occupy many other professions. Similarly, relatively many Jews were communists, because (perhaps because of the first reason) relatively many Jews were financially well to do, and could afford their children to receive a good education. It was this high education that made many young students feel that there was something wrong in European capitalists societies (or so one could argue). Suppose, if only for the sake of argument, that $\Delta^* P_k^e$ is high, with 'k' denoting Jews and 'e' denoting being a capitalist (or a communist). Suppose also that this is due mainly to $p_{ke}^{indirect}$ being high, because p_{ke}^{direct} is low. We might think of p_{ke}^{direct} to measure the amount of Jews that *would* have become capitalists even if they would have had the same possibilities as non-Jewish Europeans. Stating it somewhat differently, p_{ke}^{direct} measures the amount of Jews that became capitalists because of their individual intention to become one, while $p_{ke}^{indirect}$ measures the amount of Jews that became capitalists because there was (almost) nothing else to choose. If such are (or were) the facts, and we generally take (17a) to be false, it shows (or would show) another empirical advantage of the causal account.[19]

5. The asymmetry of causal powers

Let us now look at one of the most obvious predicted differences between the associative analysis based on $\Delta^* P_k^e$ and the causal analysis based on p_{ke}: causality is crucially *asymmetric* (or so we assume), while correlations need not be. This is similar to causal versus non-causal analyses of counterfactuals. Whereas Lewis's (1973) analysis of counterfactuals is not necessarily asymmetric, more recent causal analyses that follow Pearl (2000) are. As a result, these causal

[18]This latter condition is meant to rule that we can't say anymore that smoking causes cancer, because this line of causation is necessarily mediated by the generation of tar in lungs due to smoking.

[19]We take it that the following type of examples could be given a similar analysis:

(i) a. Blacks are good in athletics.
b. Moroccans are good at soccer. and
c. Young male Moroccans are criminals.

analyses have to explain how to account for so-called 'backtracking counterfactuals' like 'If she came out laughing, her interview went well', counterfactuals in which the consequent cannot have been caused by the antecedent because the latter came later in time than the former.

Suppose we have a causal structure of the form $k \to e \leftarrow u$. It is well possible that in such cases $\Delta^* P^k_e = \frac{P(k|e)-P(k|\neg e)}{1-P(k|\neg e)}$ has a high value, meaning that generics of the form 'Objects of type e are (generally) of type k' are true in such circumstances according to the non-causal analysis discussed in section 2. On the causal analysis presented above, however, for the same sentence to be true, it has to be the case that the causal power of e to produce k, p_{ek}, has to be high. That, however, is impossible. To see this, recall that we defined p_{ke} in section 3 as $P(e|k, \neg u)$, where u denotes the disjunction of all potential causes of e different from k. To define p_{ek} this means that we should now consider $P(k|e, \neg b)$, where b denotes the disjunction of all alternative causes of k different from e. Assuming that k does not occur without a cause and that e is not a cause of k, it is obvious that $p_{ek} = P(k|e, \neg b) = 0$.[20] Thus, an important empirical consequence of our investigated analysis is that generic sentences are predicted to be **asymmetric**.

At first, this seems like an obviously false prediction: both of the following two generics seem true:

(18) a. People that are nervous smoke.
b. People that smoke are nervous.

Perhaps such examples simply show that causality is not *semantically* relevant for the analysis of generics, it is at most relevant for *pragmatics*: people take, perhaps wrongly, generics to say something about causal powers. Perhaps. But even then we would need a causal analysis for (18b) within pragmatics. We believe that we can provide a causal analysis for generics like (18b). But there is a price to be paid: **ambiguity**. Although most generics of the form 'ks are e' are true because of the causal power of ks to produce e, others are true because of the causal power of e-ness to produce k. To give a more detailed account of the second reading of generics, we will define the probability that, given e, e is due to k, $P(k \rightsquigarrow e|e)$. Given that we derived before that in our causal structure $k \to e \leftarrow u$, objects of type e are caused by k with probability $P(k) \times p_{ke}$, the probability that, given e, e is due to k is

(19) $P(k \rightsquigarrow e|e) \quad = \quad \frac{P(k) \times p_{ke}}{P(e)}$.[21]

Notice that in causal structure $k \to e \leftarrow u$ this value can be positive and high, while $p_{ek} = 0$. Thus, on our ambiguity analysis we will say that although most generics of the form 'Objects of type k are (generally) of type e' are true because p_{ke} is high, others are true because $P(e \rightsquigarrow k|k)$ is high. Observe that in contrast to p_{ke}, the value of $P(e \rightsquigarrow k|k)$ depends crucially on the base rates of k and e, making the latter less 'stable' than the former.[22]

We have argued above against analyses of generics that required generics to be ambiguous. But

[20] Alternatively, we might follow Pearl (2000) and measure the relevant causal power in terms of intervention as follows $P(k_e|\neg k, \neg e)$. But because in this type of causal structure intervention of e doesn't influence the probability of k, and because now $\neg k$ is taken to be true, this means that $p_{ek} = P(k_e|\neg k, \neg e) = 0$, just as it should be.

[21] See Cheng et al. (2000). Notice that in case k is the only (potential) cause of e, $p_{ke} = P(e|k)$. In that case it immediately follows that $P(k \rightsquigarrow e|e) = \frac{P(k) \times P(e|k)}{P(e)} = \frac{P(k \wedge e)}{P(e)} = P(k|e)$.

[22] Perhaps this explains why generics expressed in the 'causal order' are more natural than the others.

does the current ambiguity analysis not leave us with the same problem? Not really: in case one takes over Cheng's independence assumptions by means of which she can estimate the causal power, one can show not only that $p_{ke} = \Delta^* P^e_k$, but also that $P(e \rightsquigarrow k|k) = \Delta^* P^e_k$. Thus, as far as estimation is concerned, there is no ambiguity at all.

In this section we saw that a causal power analysis of generics has consequences for the analysis of generics in general. Whether an ambiguous, but perhaps more insightful, analysis of generics in terms of causal powers is to be preferred to a uniform, though less explanatory, analysis in terms of (stable) correlations, we must leave to the reader.

6. Conclusion and Outlook

The goal of this paper was to see to what extent a causal power analysis of generics is defensible. We have seen that such an analysis is quite appealing in the following sense: it **explains** why under natural circumstances a generic of the form '*k*s are *e*' is true iff the measure $\Delta^{**} P^e_k$ is high, an analyses that was proposed before for empirical reasons. This explanation also has the conceptually appealing feature that it seems to align with our actual thinking. It forces us to look for suitable alternative potential causes and the relevant causal structures in which they are engaged. For instance, if two kinds both exhibit the same properties, it tries to come up with a common cause explanation. This forces one to look for 'deeper' analyses than a regularity analysis does. We feel, with Cartwright (1989), that this is also the way science works. Moreover, the causal analysis also gives rise to different empirical predictions in other than the 'natural' circumstances: (i) under various conditions generics of the form '*k*s are *e*' are seen to be true, or acceptable, although $\Delta^* P^e_k$ is low, and (ii) it explains why some other generics are intuitively false, although $\Delta^* P^e_k$ and $P(e|k)$ are high. Moreover, we have seen that in various circumstances high causal power comes down to high (stable) conditional probability, which according to many authors (e.g. Cohen, 1999) is the reason why most generics are true.[23]

It has to be admitted, though, that the empirical predictions of the causal power analysis of generics gives are not obviously better than those of the correlation-based analysis,[24] and that the analysis gives rise to some new problems as well. It forces us, for instance, to assume that generics – like counterfactuals – are ambiguous (although we have argued that this is less of a problem than it might seem at first). Another potential disadvantage of the causal power approach is that its resulting empirical predictions depend very much on what we take the alternative causes and the causal structure to be. Although the causal power theory might be seen as too 'subjective' as a result of this, we think that this is actually a fact of life: the discussions about whether sentences like 'Blacks are good in athletics' are true are very much about what the causal structure is taken to be.

In this paper we have investigated whether a *semantic* analysis based on causal powers is defensible. What the above doubts about this analysis shows, one might argue, is that a causal view should play a role only in *pragmatics*. In fact, this seems to be the view defended by

[23]Another pleasing consequence is, that just like episodic sentences, generic sentences are on a causal power analysis predicted to be true just because a certain fact obtains. Because we assumed generics to have truth-makers (the causal powers) that are independent of the base rates, we predict—in contrast to purely probabilistic analyses—that generics express propositions and can be used in embedded contexts, like in 'Countries that do not honor women's rights, do not honor general human rights'.

[24]Note that neither of these analyses seem suited all by itself to account for normative generics like 'Boys don't cry'.

Haslanger (1987) and Leslie (2013): the generic 'Women are submissive' should be avoided not so much because it is not true, but rather because it gives rise to the false suggestion that the generic is true for the wrong causal reasons, i.e., because of what it is to be a women. In our words, 'Being a woman' is taken to be the *direct cause* of behaving submissive. One way to implement this suggestion is to claim that generics have truth conditions based on correlations, but that many people assume that these correlations are the way they are because of their wrong *essentialist'* reading of generics. We have suggested in section 4.1 that if essences play a key role in the causal interpretation of generics, causal power reduces naturally to conditional probability. Although this might lead to a somewhat stronger reading of generics than the one using $\Delta^* P$, it doesn't lead to the much stronger interpretation that Haslanger and Leslie object to. Many proponents of a causal power view of regularities (Harre and Madden, 1975; Ellis, 1999), however, have something stronger in mind: the regularities are not just causal, but are taken to be (metaphysically) *necessary* (whatever that might mean exactly). It is exactly against this latter strong — and we think wrong — essentialist' view of generics that Haslanger (1987) and others warn us. Haslanger argues—just like Barth (1971) before her—that because generic sentences like 'Women are submissive' and 'Bantu's are lazy' are taken to say something about the essence of, or of the real, women and Bantus, they have their malicious social impact: they introduce prejudices to children, strengthen existing ones, and are excellent strategic tools for propagandists because they are immune to counterexample: any non-submissive woman is not a real woman. We think, however, that once the connection between causal powers (or essentialism) and necessity is given up, some of Haslanger's complaints against the use of generics loose their force. It still leaves open, however, the idea that causal powers should be used in pragmatics, to account for the appropriateness of generic sentences, rather than in semantics, to account for their truth.

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Scalar inferences and cognitive load[1]

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Abstract. A number of studies have found that participants are less likely to interpret the scalar words ‘some’ and ‘or’ with an upper bound when their cognitive resources are burdened, thus suggesting that the computation of scalar inferences is cognitively effortful. We conducted two sentence-picture verification tasks to determine whether this finding generalises to other scalar words. In Exp. 1, we manipulated cognitive load by asking participants to memorise simple or complex grid patterns during the experiment (cf. De Neys and Schaeken, 2007). In Exp. 2, we manipulated cognitive load by varying the time participants could take to process the sentences and pictures (cf. Chevallier et al., 2008). In this way, we tested seven scalar words: ‘some’, ‘or’, ‘low’, ‘scarce’, ‘might’, ‘most’, and ‘try’. We expected to find lower rates of scalar inferences when participants experienced greater cognitive load, i.e., when they had to memorise complex grid patterns in Exp. 1, and when they had less processing time available in Exp. 2. We find significant effects of memory load in the expected direction, but only for positively scalar words, i.e., for scalar words that denote a lower bound. We fail to find any significant effects of processing time. We explain these findings by arguing that the scalar inferences of positively scalar words introduce negative information into the meaning of the sentence, and that the processing of such negative information is cognitively demanding.

Keywords: scalar inferences, experimental pragmatics, working memory.

1. Introduction

It is generally assumed that the *literal* meaning of scalar words, such as ‘some’ and ‘or’, is lower-bounded only. Thus, the literal meaning of (1) can be paraphrased as ‘I ate at least some and possibly all of the pie’.

(1) I ate some of the pie.

At the same time, it is clear that someone who utters (1) may imply that she did not eat all of the pie. This *scalar inference* is often explained as a conversational implicature along the following lines: someone who utters (1) could have been more informative by saying ‘I ate all of the pie’. Why didn’t she? Presumably because she did not eat all of the pie. In this way, ‘some’ acquires its *pragmatic* meaning as ‘at least some but not all’ (e.g., Horn, 1972; Gazdar, 1979).

At the theoretical level, then, the derivation of scalar inferences involves a protracted reasoning process that uses the literal interpretation in its premises. There has been a substantial amount of debate as to whether this reasoning process is reflected in the cognitive processing of scalar inferences, i.e., whether the literal meaning of scalar words is easier to retrieve than the pragmatic meaning.

On the one hand, proponents of *relevance theory* have argued that hearers initially interpret

[1]We would like to thank the organisers, reviewers, and participants of Sinn und Bedeutung 23, in particular Marieke Schouwstra and Fausto Carcassi, for their valuable feedback.

utterances with scalar words literally. If the hearer is not satisfied with the relevance of this literal interpretation, she may choose to make it more relevant by computing the scalar inference. This process of pragmatic enrichment is assumed to be cognitively effortful (e.g., Sperber and Wilson, 1986). On the other hand, Levinson (2000) made a case for the primacy of the pragmatic interpretation. Levinson argues that scalar words are standardly interpreted with an upper bound. In certain circumstances, this upper bound may be cancelled to arrive at the literal interpretation. According to Levinson, this process of cancellation is cognitively effortful.

In other words, whereas relevance theory argues that the computation of scalar inferences is associated with a processing cost, Levinson's defaultist approach holds that it is rather the cancellation of scalar inferences that is cognitively effortful.

Relevance theory and Levinson's defaultist approach make a number of conflicting empirical predictions. One such prediction centers on the effect of cognitive load on the probability of deriving scalar inferences. If the computation of scalar inferences draws upon cognitive resources, as relevance theory holds, people should be *less* likely to compute scalar inferences when their cognitive resources are burdened; by contrast, if it is the cancellation of scalar inferences that is cognitively effortful, people should be *more* likely to compute scalar inferences.

1.1. Prior work

To test these predictions, De Neys and Schaeken (2007) conducted a sentence verification task in which participants had to provide truth judgements to underinformative sentences containing the scalar word 'some', such as (2) (cf. also Bott and Noveck, 2004).

(2) a. Some dogs are mammals.
 b. Some parrots are birds.

These sentences are true on their literal interpretation but false if the scalar inference is computed and 'some' is interpreted as excluding 'all'. Hence, 'true' responses indicate that participants arrived at a literal interpretation; 'false' responses suggest that a scalar inference was computed. In what follows, we conveniently refer to these two types of responses as *literal* and *pragmatic*, respectively.

While providing their truth judgements, participants in De Neys and Schaeken's experiment had to memorise dot patterns in 3×3 matrices. These dot patterns were either *simple*, consisting of three dots in a horizontal or vertical line, or *complex*, consisting of four dots scattered across the matrix. In this way, De Neys and Schaeken manipulated the degree of cognitive load that participants experienced while they evaluated the target sentences.

In line with the relevance-theoretic predictions, participants were less likely to respond pragmatically if they had to memorise complex dot patterns (73%) compared to simple ones (79%). Thus, greater cognitive load decreased the probability that participants computed scalar inferences. De Neys and Schaeken's results have since been replicated in at least three studies (Dieussaert et al., 2011; Marty and Chemla, 2013; Marty et al., 2013).

Chevallier et al. (2008) provide a second piece of evidence in favour of relevance theory. Their study focuses on the interpretation of 'or' rather than 'some'. Participants in their Exp. 1 were presented with strings of letters that were described by means of sentences such as (3).

(3) There is an A or a B.

Participants had to indicate if the sentence was a correct description of the letter string. In the target condition, the corresponding letter string contained both an A and a B, thus verifying the sentence on its literal interpretation but falsifying the scalar inference.

There were three versions of the experiment. In the *fast* version, participants saw the letter string for one second. Afterwards, the letter string disappeared and was replaced by the sentence. The *normal* version was identical to the fast version, except that the letter string remained on screen when the sentence was presented. The *slow* version was identical to the normal version, except that participants had to wait for three seconds after the presentation of the sentence before they were allowed to respond. In this way, Chevallier et al. manipulated the time and effort that participants could invest in the verification task.

In line with the relevance-theoretic predictions, participants were more likely to respond pragmatically when they had more time to process the sentences. Thus, in the fast version, participants responded pragmatically 20% of the time; in the normal version, 25%, and in the slow version, 48%.

1.2. Broadening the scope

The memory load effect of De Neys and Schaeken and the processing time effect of Chevallier et al. have been shown for two scalar words only: 'some' and 'or'. However, if these effects are to be taken as evidence for relevance theory, rather than simply as refuting Levinson's defaultist approach, they should generalise across the entire family of scalar words. In recent work, we have shown that this *uniformity assumption* may not hold, at least when it concerns De Neys and Schaeken's memory load effect (van Tiel et al., 2019).

Van Tiel et al. tested seven scalar words: 'low', 'scarce', 'might', 'or', 'some', 'most', and 'try'. For each of the seven scalar words, van Tiel et al. constructed a sentence and three types of pictures: one in which the sentence was unambiguously true, one in which it was unambiguously false, and one in which the sentence was literally true but false if the corresponding scalar inference was derived. The first two picture types constitute the control condition; the third picture type the target condition. Table 1 shows example sentences and pictures for each scalar word.

Participants were presented with sentences and pictures, and they had to indicate if the sentence adequately described the picture. In Exp. 2, van Tiel et al. manipulated the degree of cognitive load that participants experienced in a similar way to De Neys and Schaeken (2007). Thus, participants were assigned to one of three conditions: in the no-load condition, participants did not experience any cognitive load; in the low-load condition, participants had to memorise simple patterns consisting of three horizontally aligned black squares in a 3×3 matrix; in the high-load condition, participants had to memorise more complex patterns consisting of four black squares in a 3×3 matrix. See Fig. 1 for example grids.

Van Tiel et al. observed significant negative effects of cognitive load for 'might', 'or', 'some', 'most' on the probability that participants responded pragmatically in the target condition. Participants were thus less likely to derive the scalar inferences associated with these scalar words when they were under greater cognitive load. However, the probability of pragmatic responses

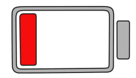
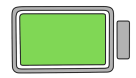
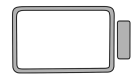
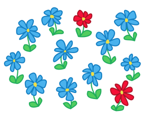
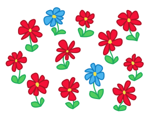
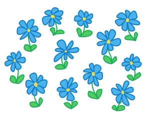
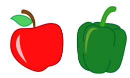
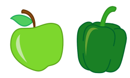
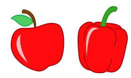
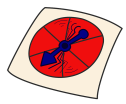
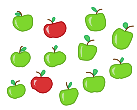
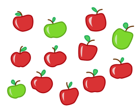
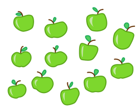
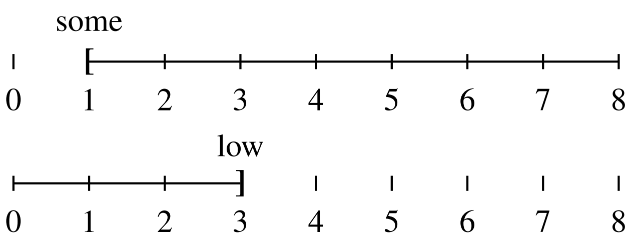
Sentence	*Control (T)*	*Control (F)*	*Target*
The battery is low.			
Red flowers are scarce.			
Either the apple or the pepper is red.			
The arrow might land on red.			
Some of the socks are pink.			
Most of the apples are green.			
He tried to tie his tie.			

Table 1: Sentences and example pictures for each scalar term from van Tiel et al. (2019).

for 'low', 'scarce', and 'try ' was independent of the degree of cognitive load.

Van Tiel et al. explain these findings based on the notion of *scalarity*. Scalar words are either *positively* or *negatively* scalar depending on whether they denote a lower or upper bound on their dimension (e.g., Horn, 1989; Matsumoto, 1995). Thus, 'some' is positively scalar because it denotes a lower bound: if the pie from example (1) consists of eight slices, the meaning of 'some of the pie' can be visualised as in (4a). Conversely, 'low' is negatively scalar because it denotes an upper bound on its dimension. Hence, the meaning of 'low on pie' can be visualised as in (4b).

(4) a. b.



The notion of scalarity is akin to that of *monotonicity*. Hence, another way of bringing out the contrast between 'some' and 'low' is by inspecting their inferential potential: 'some' allows

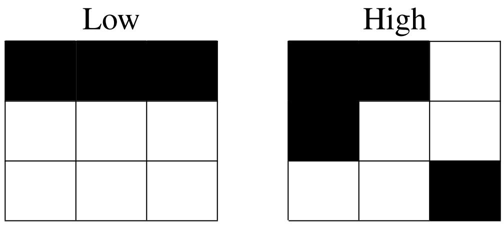


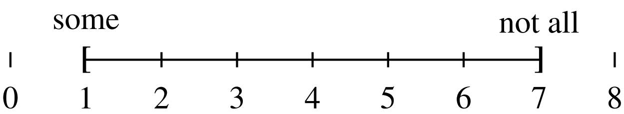
Figure 1: Examples of low-load and high-load matrices that participants had to memorise in van Tiel et al. (2019: Exp. 2).

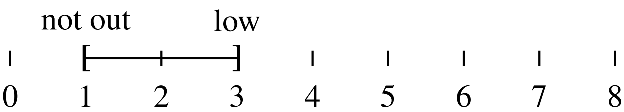
for inferences from a set to its superset, as shown by the validity of the argument in (5a); 'low' allows for inferences from a set to its subset, as shown by the validity of the argument in (5b). In both cases, the argument becomes invalid if the premise and conclusion are reversed.

(5) a. I ate some of the apple pie. ⇒ I ate some of the pie.
b. We are low on pie. ⇒ We are low on apple pie.

'Scarce' patterns with 'low' in that it is negatively scalar; 'or', 'might', 'most', and 'try' are positively scalar, just like 'some'.

The scalarity of a word determines, among other things, the polarity of the corresponding scalar inference: positively scalar words give rise to negative, i.e., upper-bounding scalar inferences; negatively scalar words to positive, i.e., lower-bounding scalar inferences. Thus, the pragmatically enriched meanings of 'some of the pie' implying 'not all of the pie' and 'low on pie' implying 'not out of pie' can be visualised as in (6).

(6) a.


b.


Note that the negativity of the scalar inferences of positively scalar words is not reflected in any negative elements in the surface form of the scalars; rather, their negativity is implicit, involving the placement of an upper bound on the dimension over which the scalar word quantifies (cf. Horn, 1989: p. 188ff.).

Van Tiel et al. argue that the scalar inferences of positively scalar words are cognitively demanding because they introduce a negative proposition into the meaning of the sentence. There is a substantial body of evidence showing that the processing of negative information is cognitively effortful (e.g., Clark and Chase, 1973; Deschamps et al., 2015; Geurts et al., 2010). Hence, the derivation of the scalar inferences of positively scalar words—but not negatively scalar ones—is associated with a processing cost.

There are, however, three observations that sit uneasily with this explanation. First, 'try', which is positively scalar, did not show a significant effect of cognitive load. Second, the cognitive load effects for the other positively scalar words were found primarily in the comparison between the no-load and low-load conditions, rather than between the low-load and high-load conditions, which is what De Neys and Schaeken found for ‘some’. Third, the effect of memory load on the probability of deriving the scalar inferences of positively scalar words did not always differ significantly from its effect on negatively scalar words.

1.3. Current study

One possible explanation for this less than perfectly consistent pattern of results is that the difference in complexity between the grids in the low-load and high-load conditions was not sufficiently pronounced to affect the probability of pragmatic responses.Thus, the effect of memory load on the probability of pragmatic responses may become more robust if the difference in complexity between the low-load and high-load conditions becomes more pronounced. In order to evaluate this explanation, and to obtain a better understanding of the effect of cognitive load on scalar inferences, we conducted two sentence-picture verification tasks.

Exp. 1 replicated van Tiel et al.’s Exp. 2 with grids that differed more prominently in complexity. Specifically, participants were assigned to one of two conditions: in the *minimal-load* condition, participants had to memorise patterns consisting of one black square in a 2×2 matrix; in the *maximal-load* condition, participants had to memorise patterns consisting of four black squares in a 4×4 matrix. Fig. 2 shows example grids from both conditions.

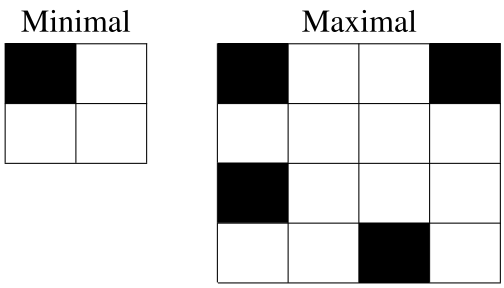


Figure 2: Examples of minimal-load and maximal-load matrices that participants had to memorise in Exp. 1.

Afterwards, as a second test of the effect of cognitive load on the derivation of scalar inferences, Exp. 2 investigates the generalisability of the results found by Chevallier et al. by testing the same seven scalar words as in Exp. 1 within their experimental paradigm. That is, three versions of the sentence-picture verification task were constructed: in the fast version, the picture was briefly presented and then replaced by the sentence; in the normal version, the picture remained on screen when the sentence was presented, and in the slow version, participants had to wait for three seconds before registering their truth judgements.

Taken together, these two experiments provide an insight into the effect of cognitive load on the derivation of scalar inferences. We distinguish two possible hypotheses. On the naive view that the processing of all varieties of scalar inferences should proceed along the same lines, it is expected that increased cognitive load should decrease the probability of deriving the scalar inferences of all seven scalar words. If, however, van Tiel et al.’s scalarity-based explanation is on the right track, it is expected that increased cognitive load only decreases the probability of deriving the scalar inferences of the positively scalar words ‘might’, ‘or’, ‘some’, ‘most’, and ‘try’, but not the negatively scalar words ‘low’ and ‘scarce’.

In the next sections, we describe the two experiments in more detail.

2. Experiment 1

2.1. Participants

100 participants (mean age: 36, standard deviation: 10, range: 21–71, 38 females) were drafted on Mechanical Turk and were paid $2.00 for their participation. Participants were asked to indicate their native language, but payment was not contingent on their response to this question. All of the participants indicated that they were native speakers of English.

2.2. Materials

The materials were the same as in van Tiel et al. (2019: Exp. 2).

That is, the experiment tested seven scales: ⟨low, empty⟩, ⟨scarce, absent⟩, ⟨or, and⟩, ⟨may, must⟩, ⟨might, will⟩, ⟨some, all⟩, ⟨most, all⟩, and ⟨try, succeed⟩. Each scale was associated with one sentence with the weaker scalar term. These sentences were paired with three types of pictures. In one picture type, the sentence was unambiguously true (‘true’ control condition), in one picture type, it was unambiguously false (‘false’ control condition), and in one picture type, the truth value of the sentence depended on whether the corresponding scalar inference was computed (target condition). That is, the sentence was true if it was interpreted literally but false if the corresponding scalar inference was computed. There were three slightly different tokens of each type of picture. Table 1 shows the seven sentences and example tokens of each picture type. The order of the items was completely randomised for each participant.

Each trial started with the presentation of a pattern of black squares in a matrix. The patterns in the minimal-load condition consisted of one black square in a 2×2 matrix. The patterns in the maximal-load condition consisted of four black squares in a 4×4 matrix. The black squares were never horizontally or vertically contiguous. Fig. 2 shows example matrices from both conditions.

2.3. Procedure

Each trial started with the presentation of a matrix, which appeared on screen for 1,200 msec. Participants were instructed to memorise the pattern in these matrices. Afterwards, a sentence and a picture were presented in the middle of the screen. Participants had to decide whether or not the sentence was a good description of the depicted situation. They could register their decision by pressing either ‘1’ (good description) or ‘2’ (bad description) on their keyboard. Once they had registered their decision, they saw an empty matrix and had to recreate the pattern that was presented at the start of the trial. To this end, participants could fill or unfill squares in the matrix by clicking on them. No feedback was given on their performance.

2.4. Data treatment

11 participants were removed for making mistakes in more than 20% of the control items. The mean error rate on control items of the remaining participants was 3.4% in the maximal-load condition and 1.6% in the minimal-load condition. In addition, we removed three participants

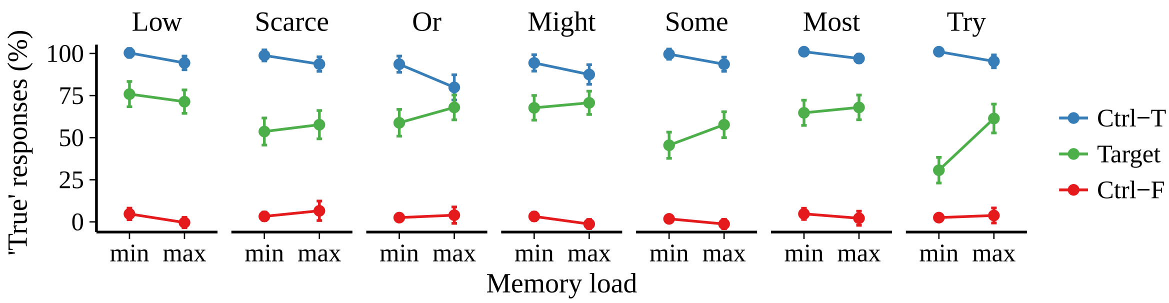


Figure 3: Percentage of ‘true’ responses for each scalar term, condition, and memory load (min = minimal load, max = maximal load).

from the maximal-load condition because they correctly recalled fewer than 10% of the matrices. The mean error rate on the matrix recall task was 45% in the maximal-load condition and 2.8% in the minimal-load condition. 86 participants were thus included in the analyses.

We removed items with a response time below 500 milliseconds or above 15 seconds, assuming that these correspond to accidental button presses or a lack of concentration on the task at hand (0.8% of the data).

2.5. Memory load

Fig. 3 shows the percentages of ‘true’ responses for each scalar term, condition, and memory load. In the control condition, performance was close to ceiling (all error rates $< 11\%$). The only apparent exception was the ‘true’ control condition of ‘or’, for which performance dropped from 4.3% errors in the minimal-load condition to 13.2% in the maximal-load condition (cf. Chevallier et al., 2010, for similar findings).

In order to determine whether there were significant effects of memory load on the probability of pragmatic answers in the target condition, we constructed, for each scalar word, a mixed effects logistic regression model predicting responses in the target condition (literal or pragmatic) based on memory load, including random intercepts for participants and items, which was the maximal converging model for most of the scalar words. There were significant negative effects of memory load for ‘or’ ($\beta = 2.55$, $SE = 1.15$, $t = 2.21$, $p = .027$), ‘some’, ($\beta = 2.21$, $SE = 1.13$, $t = 1.97$, $p = .049$), and ‘try’ ($\beta = 3.13$, $SE = 1.18$, $t = 2.65$, $p = .008$), but not for any of the remaining scalar words (all t’s < 1.3).

To obtain a more complete picture, we also conducted an analysis in which we included the data reported by van Tiel et al. (2019: Exp. 2).[2] Thus, we have a data set with data from 250 participants who did the same sentence-picture verification task under five levels of cognitive load: no load, minimal load, low load, high load, and maximal load. Fig. 4 shows the percentages of ‘true’ responses for each scalar term, condition, and memory load.

Again, in order to determine whether there were significant effects of memory load on the probability of pragmatic answers in the target condition, we constructed, for each scalar word,

[2] These data can be found at: https://data.mendeley.com/datasets/zpfm55nr33/1

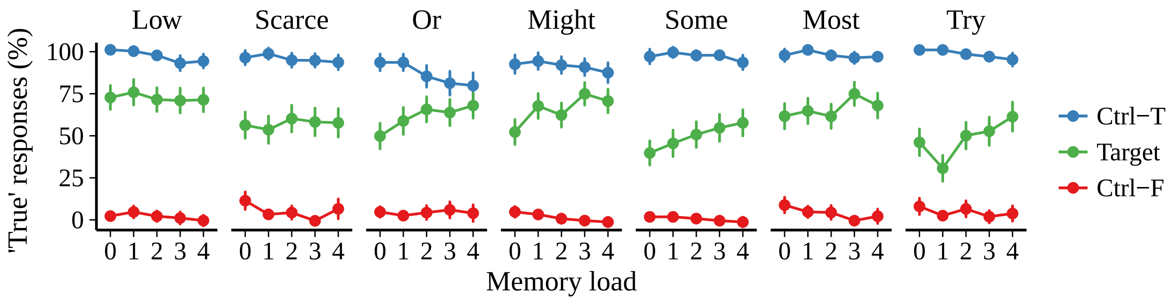


Figure 4: Percentage of 'true' responses for each scalar term, condition, and memory load. 0 = no load, 1 = minimal load, 2 = low load, 3 = high load, 4 = maximal load. The results from the no-load, low-load, and high-load conditions are taken from van Tiel et al. (2019: Exp. 2). Error bars represent standard errors of the mean.

	Scarce	Or	Might	Some	Most	Try
Low	< 1	2.97 **	3.23 **	2.65 **	1.77 ·	3.87 ***
Scarce		2.40 *	2.71 **	2.56 *	1.20	2.99 **
Or			< 1	< 1	1.28	< 1
Might				< 1	1.85 ·	< 1
Some					1.38	< 1
Most						1.37

Table 2: Z and p values indicating whether the interaction between scalar term and memory load had a significant effect on responses in the target condition for each pair of scalar terms. Note: · indicates significance at the .10 level; * at the .05 level; ** at the .01 level; *** at the .001 level.

a mixed effects logistic regression model predicting responses in the target condition (literal or pragmatic) based on memory load (no, minimal, low, high, or maximal), including random intercepts for participants and items, which was the maximal converging model for most of the scalar words. There were significant negative linear effects of memory load for 'or' ($\beta = 2.99$, $SE = 1.00$, $t = 2.99$, $p = .003$), 'might', ($\beta = 10.97$, $SE = 1.47$, $t = 7.44$, $p < .001$), 'some' ($\beta = 2.64$, $SE = 0.92$, $t = 2.88$, $p = .004$), 'most' ($\beta = 1.80$, $SE = 0.91$, $t = 1.98$, $p = .048$), and 'try' ($\beta = 2.68$, $SE = 0.91$, $t = 2.94$, $p = .003$), but not the other two scalar words (both t's < 1).

To determine if the effect of memory load differed across scalar words, we constructed, for the target condition of each pair of scalar words, a generalised mixed effects logistic regression model predicting response ('true' or 'false') on the basis of memory load (no, minimal, low, high, or maximal), scalar word, and their interaction. Again, these analyses only included random intercepts for participants due to convergence issues. The significance of the interactions between memory load and scalar term is provided in Table 2.

The results of this analysis largely confirm the results of the previous analyses: there was a significantly stronger negative effect of memory load on the probability of pragmatic responses for 'or', 'might', 'some', and 'try' than for 'low' and 'scarce'; none of the other comparisons were statistically significant.

In summary, the results of Exp. 1 indicate that, for the positively scalar words ‘or’, ‘some’, and ‘try’, participants were significantly less likely to respond pragmatically when they had to memorise complex matrices than simple ones; no such effect was found for the negatively scalar words ‘low’ and ‘scarce’. Perhaps surprisingly, though, the positively scalar words ‘might’ and ‘most’ patterned with ‘low’ and ‘scarce’. However, once we also included into our analyses the data from van Tiel et al. (2019: Exp. 2), a more consistent pattern emerged, with all of the positively scalar words showing a significant effect of memory load in the expected direction, and no effect of memory load on their negatively scalar counterparts. Indeed, the effect of memory load on the response patterns for the positively scalar words ‘or’, ‘might’, ‘some’, and ‘try’—but not ‘most’—differed significantly from its effect on the response patterns for the negatively scalar words ‘low’ and ‘scarce’.

3. Experiment 2

3.1. Participants

150 participants (mean age: 34, standard deviation: 10, range: 17–69, 60 females) were drafted on Mechanical Turk and were paid $2.00 for their participation. Participants were asked to indicate their native language, but payment was not contingent on their response to this question. Two participants were removed from the analyses for having a native language other than English.

3.2. Materials

The materials were the same as for Exp. 1. However, participants in Exp. 2 did not have to memorise any grid patterns during the sentence-picture verification task.

3.3. Procedure

The procedure was analogous to Chevallier et al. (2010: Exp. 1).

Participants were presented with sentences and pictures, and they had to decide whether or not the sentence was a good description of the depicted situation. They could register their decision by pressing either ‘1’ (good description) or ‘0’ (bad description) on their keyboard.

There were three versions of the experiment. In the *fast* version, trials started with the presentation of the picture in the middle of the screen. After one second, the picture disappeared and was replaced by the sentence. The sentence remained on screen until participants registered their truth judgements. The *normal* version was identical to the fast version, except that the picture remained on screen when the sentence was presented. The *slow* version was identical to the normal version, except that participants had to wait for three seconds after sentence onset before providing their truth judgements. If they pressed one of the response buttons before three seconds had passed, the message ‘Too fast!’ appeared on screen and remained there for three seconds.

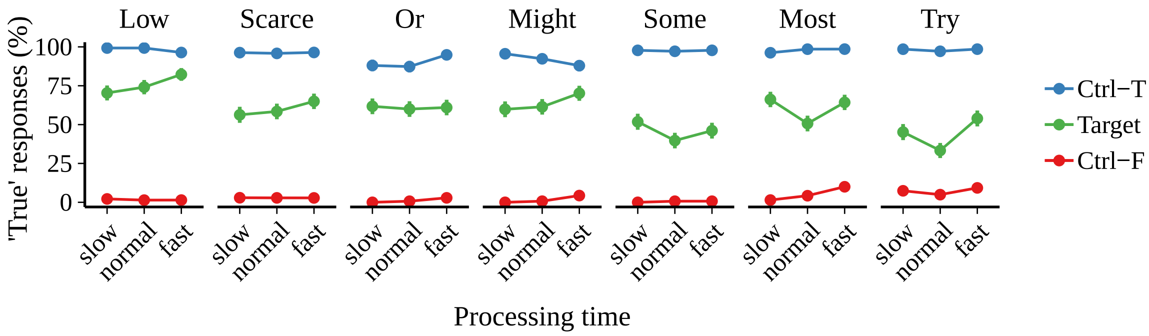


Figure 5: Percentage of 'true' responses for each scalar term, condition, and version. Error bars represent standard errors of the mean.

3.4. Data treatment

8 participants were removed for making mistakes in more than 20% of the control items. The mean error rate on control items of the remaining participants was 3.6%. 140 participants were thus included in the analyses.

We removed items with a response time below 200 milliseconds or above 10 seconds, assuming that these correspond to accidental button presses or a lack of concentration on the task at hand (2.1% of the data).

3.5. Processing time

Fig. 4 shows the percentages of 'true' responses in the target condition for each scalar term and version (fast, normal, or slow). In order to determine if there were significant effects of version on the probability of pragmatic answers in the target condition, we constructed, for each scalar word, a mixed effects logistic regression model predicting responses in the target condition (literal or pragmatic) on the basis of version (fast, normal, or slow), including random intercepts for participants and items, which was the maximal converging model for most of the scalar words. There were no significant linear effects of version for any of the scalar words: 'might' (β = -1.49, SE = 0.98, Z = -1.51, p = .130), 'try', (β = -0.82, SE = 0.75, Z = -1.09, p = .275), nor any of the remaining scalar words (all Z's of the remaining words being < 1).

The results of Exp. 2 thus contradict previous findings by Chevallier et al. (2008), who found that participants were significantly more likely to interpret 'or' with an upper bound in the slow condition compared to both the fast and normal conditions. We did not find reliable effects of processing time for any of the scalar words that we tested, including 'or'.

4. General discussion

This study investigated the effect of cognitive load on the probability that participants derived the scalar inferences of seven scalar words: 'low', 'scarce', 'might', 'or', 'some', 'most', and 'try'.

Exp. 1 manipulated cognitive load by asking participants to memorise simple or complex grid patterns while they compared sentences against pictures. At a first glance, the results were puzzling: participants were significantly less likely to respond pragmatically to sentences with the scalar words ‘or’, ‘some’, and ‘try’ when they had to memorise complex grids, but there was no effect of memory load for any of the other scalar words. Once we also included into our analysis the data reported by van Tiel et al. (2019: Exp. 2), however, a more consistent pattern emerged, with participants being increasingly less likely to derive the scalar inferences of the positively scalar words ‘might’, ‘or’, ‘some’, ‘most’, and ‘try’—but not the negatively scalar words ‘low’ and ‘scarce’—when they were under greater cognitive load.

These data taken together resolve the shortcomings from van Tiel et al. (2019) which we mentioned above. The minimal- and maximal-load matrices lead to a clearer differentiation of the cognitive load effect, and ‘try’ now reliably patterns with the other positively scalar words, whose behaviour differs significantly from that of the negatively scalar words.

From a methodological perspective, the results of Exp. 1 show that the effect of memory load on the probability of scalar inferencing is difficult to detect. Thus, neither Exp. 1 nor van Tiel et al.’s (2019) Exp. 2 yielded a consistent set of results. Only when the results of the two experiments were put together did a consistent pattern of results emerge.

The volatility of the effect of memory load does not seem to be due to a lack of power: De Neys and Schaeken (2007) tested 56 participants; Marty and Chemla (2013) 16 participants; Marty et al. (2013) 26 participants, and Dieussaert et al. (2011) 106 participants—our Exp. 1 tested 100 participants. One notable departure from previous studies is that we tested memory load between participants rather than within. However, from a theoretical perspective, this difference should not influence the results (cf. also Charness et al., 2012).

Exp. 2 manipulated cognitive load by varying the amount of time and effort participants could invest in the sentence-picture verification task. In the fast version of the experiment, participants saw the picture for a brief amount of time, whereupon it was replaced by the sentence; in the normal condition, the picture remained on screen when the sentence was presented; in the slow condition, participants were forced to wait for three seconds before providing their truth judgements. Unlike the results reported by Chevallier et al. (2008), we failed to find significant effects of processing time on the probability of deriving the scalar inferences of any of the seven scalar words.

Again, the failure to replicate Chevallier et al.’s results cannot be attributed to a lack of power: Chevallier et al. tested 59 participants, whereas we tested 150. In both cases, the available processing time was manipulated between participants.

Further research should determine whether the failure to replicate Chevallier et al.’s results is incidental or whether the available processing time really does not influence the rates of scalar inferences. More generally, also given the unstable results from the memory load experiments, it may be worthwhile to investigate the robustness of results from the experimental pragmatics literature in a more systematic and comprehensive way, as has been already done in various other fields (e.g. Cova et al., 2018; Open Science Collaboration, 2015).

Such a large-scale replication should also take into consideration data from other experimental tasks, such as eye-tracking (e.g., Huang and Snedeker, 2009), reading times (e.g., Politzer-Ahles and Husband, 2018), and ERP (e.g., Barbet and Thierry, 2018). Results from these experimental tasks seem more equivocal about the presence or absence of a processing cost for scalar inferencing, when compared to the results from sentence-picture verification tasks.

From a theoretical perspective, the results of Exp. 1 are in line with the view espoused by van Tiel et al. (2019) that the derivation of scalar inferences is not cognitively demanding per se, but only if the scalar inference introduces a negative proposition into the meaning of the sentence, as is the case for positively scalar words.

It has been shown that sentences that express negative information, even implicitly, are cognitively (e.g., Clark, 1970), semantically (e.g., Bierwisch, 1967), and syntactically (e.g., Heim, 2006) marked relative to sentences that do not. The late acquisition of negative scalar adjectives, such as ‘short’ and ‘low’, compared to their positive scalar counterparts ‘tall’ and ‘high’, also confirms the difficulty that underlies the processing of negative information (e.g., Klatzky et al., 1973).

A further question is *why* the processing of negative information should be cognitively costly. At least two possible answers to this question can be distinguished. One possibility is that hearers evaluate negative sentences by first evaluating their positive counterparts and then reversing the truth value, whereas positive sentences are evaluated directly (e.g., Clark and Chase, 1973). A second possibility is that negative sentences presuppose an expectation that their positive counterparts are true. The accommodation of this presupposition may be what makes the processing of negative information cognitively demanding (e.g., Moxey, 2006).

In either case, it seems plausible to suppose that the alleged processing cost of scalar inferences is in fact an idiosyncracy due to the fact that most research has hitherto been concerned with positively scalar words, such as ‘some’ and ‘or’, rather than with negatively scalar words (but cf. Cremers and Chemla, 2014; Romoli and Schwarz, 2015).

It follows from the scalarity-based explanation that the apparent processing cost that has been observed for the scalar inferences of ‘some’ and ‘or’ should not be construed as evidence for the relevance-theoretic view that pragmatic inferencing is necessarily cognitively effortful. At the same time, the experimental record also fails to corroborate the defaultist prediction that scalar inferences are derived automatically, and that it is their overturning that is cognitively effortful. Rather, it seems that the literal and pragmatic meanings of scalar words can be accessed in parallel, without an intrinsic processing cost for either interpretation.

Of course, in order to arrive at a more decisive verdict about the adequacy of the scalarity-based explanation, it will be necessary to extend the purview to a larger sample of scalar words and experimental tasks. We leave this enterprise to future research.

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Partitives, multipliers and subatomic quantification[1]

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Abstract. In standard lattice-theoretic approaches to natural language (e.g., Link, 1983, Landman, 2000, Champollion, 2017) singularities and pluralities are presumed to involve two distinct mereological structures and it is commonly supposed that quantificational expressions do not access subatomic part-whole relations. In this paper, I argue that i) certain quantificational expressions are sensitive to subatomic part-whole structures, ii) quantification over parts is subject to identical restrictions as quantification over wholes and iii) counting presupposes certain topological relations. I present new evidence in favor of a mereotopological approach to natural language (cf. Grimm, 2012) as well as novel data concerning the interaction between quantification and subatomic part-whole relations.

Keywords: mereology, mereotopology, quantification, partitivity, countability.

1. Introduction

There is an ontological intuition dating back at least to Pre-Socratics that entities are often made up of smaller entities, i.e., parts, related to each other in a particular manner (see Varzi, 2016 for an historical overview). This is in accord with a cognitive fact that humans conceive entities as being made up of smaller entities related to each other in a particular manner (e.g., Elkind et al., 1964). The vital question this article will attempt to address is to what extent this fact is relevant for natural language semantics.

In this paper, I will provide novel evidence that natural language semantics is sensitive to subatomic part-whole structures and argue that SUBATOMIC QUANTIFICATION, i.e., quantification over parts, is subject to identical restrictions as quantification over wholes. Specifically, I will postulate that counting presupposes particular topological relations that cannot be captured in frameworks grounded in standard mereology but rather call for a more fine-grained mereotopological account (see Casati and Varzi, 1999 and Grimm, 2012). The evidence comes from the cross-linguistic distribution of proportional quantifiers, different types of partitives in Italian and Polish as well as multipliers such as English *double*. Though the focus of the article is limited to concrete nouns only, I believe that the novel perspective presented here will eventually allow to develop also a proper approach to the semantics of abstract nouns.

The paper is structured as follows. In Section 2, I briefly revise several standard assumptions in mereology that faced criticism due to their inadequacy with respect to modelling wholes. In Section 3, I present a conceptual framework consisting of a meretopological approach, general counting principles and constraints on subatomic quantification. Through this lens, I will dis-

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cuss novel evidence for a mereotopological account for nominal semantics presented in Section 4. In particular, I will examine the parallelism between partitive constructions involving singulars and plurals, partitives with Italian irregular plurals, Polish topology-sensitive proportional quantifiers and, finally, multipliers. In Section 5, I will propose a semantics for a significant subset of the discussed expressions which will be based on mereotopology. Finally, Section 6 concludes the article.

2. Mereology and it limits

2.1. Standard assumptions in lattice-theoretical approaches to natural language

Since Link (1983) the main stream of the research on pluralities is grounded in standard mereology.[2] It is commonly assumed that there is only one primitive notion, i.e., the PARTHOOD relation ($\sqsubseteq$), which is accompanied with the derived notion of SUM ($\sqcup$).[3] A consequence of such a move is that in models employing mereology entities are essentially equivalent to sums of their parts neglecting the manner in which those parts are arranged.[4]

Another standard assumption that dates back to Link is that of SORTED DOMAINS distinguishing between the domain of individuals and the domain of portions of matter over which different parthood relations are defined, i.e., the individual parthood relation $\sqsubseteq_i$ as opposed to the material parthood relation $\sqsubseteq_m$, respectively. Those domains are related via mapping between the two.[5] Though $\sqsubseteq_i$ and $\sqsubseteq_m$ are analogous in a sense, formally they are different relations.[6]

The final standard assumption in theories of plurality to be discussed here concerns ATOMICITY. Though particular theories differ significantly, the mass/count distinction is usually accounted for by postulating atoms, i.e., minimal building blocks, in the denotations of count nouns and the lack thereof in the denotations of mass nouns.[7] Atoms are typically defined as mereological entities that have no proper parts.

The combination of the assumptions described above results in that there is virtually no relationship between $\sqsubseteq$ and the intuitive notion of parthood as expressed by the use of the English phrase *part of*. Though certain semanticists argue that this is a flaw of mereology (e.g., Moltmann, 1997), the mainstream response is that formal notions should not be constrained by the meaning of natural-language expressions they might be inspired by (e.g., Pianesi, 2002 and Champollion, 2017). In principle, I agree with such an argument. However, it does not rule out a possibility that the way how an expression such as *part of* is understood can give us certain hints with respect to how to model parthood so that it fits well natural language. As I will argue in the following sections, I believe we can gain a lot by exploring such a possibility.

[2]But see, e.g., Schwarzschild (1996) for a system based on set theory.
[3]See also Champollion and Krifka (2016) for an overview of systems taking $\sqcup$ to be the primitive and deriving $\sqsubseteq$.
[4]Opposing views have been expressed, e.g., by Grimm (2012) and Sutton and Filip (2017).
[5]The distinction can be also postulated in the domain of eventualities where it distinguishes between events and processes, as proposed by Bach (1986).
[6]Again, dissenting views have been expressed in the literature, e.g., by Moltmann (1997) and Landman (2016).
[7]Notable exceptions include, e.g., Krifka (1989), Grimm (2012) and Landman (2016).

2.2. Criticism of mereology

As pointed out by many authors, one factor that motivates extending standard mereology with auxiliary notions is its inadequacy in modeling objects in the real world. In particular, mereology is committed to unrestricted sum formation and as such it is insufficient to capture what it means to be a whole. This results in diametrical discrepancies between intuitions regarding the nature of entities in the world and objects mereology actually delivers. To use Casati and Varzi (1999)'s example, imagine a cup and broken glass. Intuitively, the first constitutes an object, i.e., an individuated whole, something that counts as one, whereas the other is just a collection of shards. However, this distinction cannot be captured by describing entities purely in terms of parthood. This is because in mereology for every whole there is a set of parts and for every arbitrary collection of parts there is their sum, i.e., a complete whole. As a result, a cup and broken glass have the very same mereological status. In other words, the allowance of scattered entities makes it impossible to differentiate between them and individuals constituting integrated wholes. Consequently, mereology has faced criticism that in principle it fails as a theory of individuals.

Before I move on to the discussion of novel evidence indicating that standard mereology is insufficient for a proper account for nominal semantics in natural language and instead a more subtle mereotopological perspective is required, I will introduce the key elements of the conceptual background I assume here.

3. Conceptual background

3.1. Mereotopological notions in natural language

It is trivial to state that topological notions play an important role in natural language. The existence of locative prepositions such as *inside*, *near* and *between* shows that relations concerning how we conceptualize position and space are deeply rooted in grammar. Though the research on locatives is well-established and contributed to our understanding what means language uses to encode information regarding location of objects with respect to each other (e.g., Zwarts and Winter, 1997 and Kracht, 2002), the question concerning spatial constitution of entities remains somewhat elusive in the study of meaning. One line of argumentation justifying why this kind of issues should remain unaddressed is that they simply stem from every-day world knowledge, and thus as extra-linguistic factors are not supposed to be incorporated into semantic theory (e.g., Schwarzschild, 1996).

At first sight, such an approach might seem plausible. However, there are a number of natural language expressions that are sensitive to topological properties of part-whole structures corresponding to their referents. For instance, recent research on different types of collective nouns and mass terms points to the relevance of topology in nominal semantics. In particular, Grimm (2012) proposes that a subset of mass nouns that denote aggregates of granular objects such as *rice* and *gravel* involve reference to clustered individuals, i.e., bundled entities transitively connected to each other. Similar, Henderson (2017) argues that swarm nouns such as *grove* and *horde* denote large pluralities whose constituents remain in proximity within a certain spatial configuration. Finally, as proposed by Grimm (2012) referents of concrete count nouns can be viewed as entities whose part-whole structure is constrained in such a way that it forms an integrated object in its own right.

The distinction between integrated objects and arbitrary sums can be captured by means of mereotopology, i.e., mereology augmented with topological notions.[8] The crucial topological notion for the purpose of this paper is CONNECTEDNESS (C). This relation is introduced in such a way that it interacts with other definitions and axioms of standard mereology. It is reflexive and symmetric (but not transitive) and it is implied by OVERLAP (O).

Given such an extension, a number of mereotopological properties can be defined in order to enable us to draw subtle distinctions between different spatial configurations that entities may be in. One of such notions is INTERNAL PART (IP), as defined in (1). For instance, an individual *a* is an internal part of an individual *b* if every entity that is connected to *a* overlaps with *b* or, in other words, *b* includes *a*.

(1) $\textsc{ip}(x,y) \overset{\text{def}}{=} x \sqsubseteq y \wedge \forall z[\textsc{c}(z,x) \rightarrow \textsc{o}(z,y)]$

This allows us to define the notion of INTERIOR (*i*), see (2), which is taken to be the sum of an individual's internal parts.

(2) $ix \overset{\text{def}}{=} \sqcup X$ where $X = \{y \ : \ \textsc{ip}(y,x) = \textsc{True}\}$

As a result, it is possible to derive even more complex properties in order to distinguish between entities which come in one piece as opposed to arbitrary sums which bear no topological commitments. For this purpose, it is essential to introduce the property of SELF-CONNECTED (SC), see (3). Unlike arbitrary sums, SC entities cannot be divided into separated parts since an entity is self-connected if and only if any two parts that form the whole of that entity are connected to each other.

(3) $\textsc{sc}(x) \overset{\text{def}}{=} \forall y \forall z[\forall w(\textsc{o}(w,x) \leftrightarrow (\textsc{o}(w,y) \vee \textsc{o}(w,z))) \rightarrow \textsc{c}(y,z)]$

Though self-connectedness is a great improvement, this notion is still insufficient to capture what it means to be an integrated whole since it allows for configurations involving only external connection. In order to rule out cases in which objects only touch each other, it is necessary to guarantee that not only boundaries of parts of a whole are connected to each other but also that their internal parts are shared. This can be achieved by the property of STRONGLY SELF-CONNECTED (SSC), as defined in (4).

(4) $\textsc{ssc}(x) \overset{\text{def}}{=} \textsc{sc}(x) \wedge \textsc{sc}(ix)$

Finally, a proper treatment of integrated wholes should accommodate both topological integrity and mereological maximality. Also, integrity should be evaluated relative to a property. Hence, the notion of being MAXIMALLY STRONGLY SELF-CONNECTED (MSSC), see (5), provides the final mereotopological definition of what a whole is. In prose, if an entity satisfies MSSC, then it is the largest strongly self-connected entity satisfying that property.

(5) $\textsc{mssc}(P)(x) \overset{\text{def}}{=} P(x) \wedge \textsc{ssc}(x) \wedge \forall y[P(y) \wedge \textsc{ssc}(y) \wedge \textsc{o}(y,x) \leftrightarrow y \sqsubseteq x]$

With this tool in hand, we can distinguish between integrated wholes and other types of entities.

[8] See Casati and Varzi (1999) for an excellent survey and Grimm (2012) for the first application to natural language.

3.2. General counting principles

Usually in the literature on the mass/count distinction, at some point when it comes to defining what counting is something like 'counting is quantification over what counts as one' is stated. Typically, 'what counts as one' is understood in terms of atomicity, i.e., counting is often implicitly assumed to be simply establishing one-to-one correspondence between numbers and atoms. However, such an assumption ignores certain properties of the cognitive mechanism invovled in counting (see Dehaene, 1997 for an overview). Therefore, I will attempt to provide a more explicit characterization of what counts as one. I propose that counting is a quantificational operation that is governed by three general principles restricting what kind of object can be assigned a number. I will refer to those constraints as the principle of NON-OVERLAP, MAXIMALITY, and INTEGRITY.[9]

The principle of non-overlap ensures that things that count as one need not overlap, i.e., do not share a part (cf. Landman, 2011, 2016). Guaranteeing disjointness of units of counting is necessary to avoid a possibility of an entity being counted twice. For instance, assume portions of matter a, b, c and d arranged in such a way that c overlaps with both a and b, specifically $c = a \sqcup b$. Now, one could imagine an operation that would assign numbers to all a, b, c and d. Summing them up would yield number 4 but this result is incorrect if one wanted to count how many portions of matter there are. The reason is that c is not disjoint from a and b, and thus should not be associated with a number.

The second principle concerns maximality. It states that counting requires that what is associated with a number needs to be a maximal entity of which a certain property holds. In other words, objects need to be counted in their entirety, i.e., it is disallowed to leave some parts out. To illustrate this, let us consider three distinct entities a, b and c such that c consists of two parts d and e. Now, assume a quantificational operation that satisfies the non-overlap constraint but is not restricted by the principle of maximality. When applied to the set of entities in question, it might very well yield 4 since a, b, d and e are disjoint, whereas c shares a part with both d and e. However, such an operation would not be of great help if one wanted to know how many entities are there since it fails to differentiate between wholes and their parts.[10]

Finally, the principle of integrity requires what counts as one to be conceptualized as an integrated whole, i.e., parts of an entity need to be viewed as being connected. This means that scattered entities such as substances and arbitrary sums of individuals normally are not assumed to count as one. With this respect counting differs from measuring which is not sensitive to integrity (cf. Rothstein, 2017). To illustrate this, let us consider a scenario in which someone has spilled some liquid on an empty table in such a way that there are two separate blobs a and b whose volume is 1.5 milliliters each. Though the statement in (6a) is true despite the fact that one of the 3 milliliters must be split between a portion of a and a portion of b since each of the blobs consists of 1.5 milliliters of liquid, (6b) is simply false.

[9]In accordance with the focus of this paper the proposed principles are intended to account for quantification over concrete physical objects though ultimately they would need to be more abstract in order to account for phrases such as *two ideas*. However, I will not pursue this issue here.

[10]Notice also that this constraint accounts for how we count homogeneous entities such as twigs and rocks. Given a particular counting situation, what counts as one is always the maximal entity irrespective how its part-whole structure is construed in that situation.

(6) a. There are three milliliters of liquid on the table.
b. #There are three objects on the table.

The contrast discussed above shows that units of measurement such as milliliters have different properties than objects. In other words, measuring, unlike counting, does not care about individuation in terms of integrity and it indeed appears to be a distinct operation.

3.3. Subatomic quantification

There is yet another reason to believe that defining counting as quantification over atoms, i.e., entities that have no proper parts, is not on the right track since natural language involves expressions dedicated to subatomic quantification, i.e., quantification over parts of entities. For instance, certain types of partitives and multipliers like English *double* to be discussed in Section 4 trigger this kind of quantification. I argue that the proposed set of counting principles constitutes a universal mechanism that can be applied not only to whole individuals but also when counting parts of objects. In other words, I posit that subatomic quantification is subject to the very same constraints as quantification over wholes. In particular, counting at the subatomic level presumes non-overlap, mereological maximality and topological integrity of entities subject to quantification.

Typically, counting is sensitive to the fact that some parts are cognitively more salient within the part-whole structure of an object than others. This seems to correspond to what Champollion and Krifka (2016) call structured parthood as well as to the distinction between specific and arbitrary subdivisions of a whole into parts (e.g., Markosian, 1998). Though what counts as cognitively salient parts may vary with respect to a particular context, what such parts have in common is that given a particular context they need to be disjoint. Thus, only those divisions of a whole into parts that involve non-overlapping parts can be enumerated.

Another issue concerns the principle of maximality. What counts as part of an object can also consist of smaller parts. Notice that such parts of parts also satisfy the property of being part of that object. However, the general counting principles require that only entities in their mereological entirety can can be associated with a number. This means that once a particular division of an individual into parts has been executed in a given counting context, those parts are immutable and treated as objects in their own right. Consequently, the principle of maximality applies as it would in a situation when one counts whole individuals. In other words, given a partition, non-overlapping parts are assumed to be maximal with respect to how the whole has been divided.

Finally, countability is also assumed to be governed by the principle of integrity. Note that extensions of expressions referring to parts of objects do not necessarily involve topological commitments, i.e., parts need not be continuous. For instance, there is definitely a sense in which two or more separated portions of matter within an object are part of that object. Nevertheless, similar to any arbitrary sum such an entity is not countable since associating it with a number would clearly violate the principle of integrity. In other words, a random collection of fragments of an object is not A PART of that object (cf. Acquaviva, 2008: 90–93, Champollion and Krifka, 2016). Therefore, only sets including parts that are mereologically maximal integrated entities that do not overlap can be enumerated, i.e., only a subset of possible divisions of an object is fit for counting.

Given the conceptual framework sketched here, let us turn to the question whether there is linguistic evidence that natural language is sensitive to the notions and constraints introduced. In the next section, I will argue that there is such evidence.

4. Novel evidence for a meretopological approach to natural language

4.1. Unified part-whole structure

Moltmann (1997) observes an analogy between partitives involving singular and plural terms. For instance, in German the same expression *Teil* 'part' can be used both in partitive constructions involving a singular and a plural DP in order to quantify over parts of atomic individuals and subsets of groups of individuals, respectively, see (7). In particular, in (7a) *Teil* quantifies over material parts of singular objects, i.e., functional parts or portions of a substance making up the whole individual, whereas in (7b) it quantifies over whole individuals. This fact indicates a unified parthood structure for both singular and plural individuals.

(7) a. Teil des Apfels
part of-the apple$_{\text{GEN}}$
'part of the apple'
b. Teil der Äpfel
part of-the apples
'some of the apples'

Though for some reason the analogy does not hold in the case of the English quantifier *part* (Schwarzschild, 1996: 165–166), the pattern is cross-linguistically widespread and can be observed at least in Slavic, Germanic, Romance, Celtic, Ugric, Semitic and Basque (see Wągiel, 2018 for the data). Moreover, it is systematic in that it holds also for other proportional quantifiers, see (8)–(9).

(8) a. most of the apple
b. half of the apple
c. two thirds of the apple

(9) a. most of the apples
b. half of the apples
c. two thirds of the apples

Furthermore, in many different languages partitives involving number-neutral expressions such as object mass nouns and pluralia tantum display an ambiguity between a singular and plural reading, see (10).

(10) a. část obuvi
part footwear$_{\text{GEN}}$
'part of the footwear/some of the footwear'
b. část nůžek
part scissors$_{\text{GEN}}$
'part of the scissors/some of the scissors'

A similar effect is reported to appear in some partitive constructions in languages with general number such as Japanese (Sauerland and Yatsushiro, 2004, Watanabe, 2013). For instance, despite the fact that the nominals in (11) are number-neutral, both sentences are ambiguous between a singular and plural interpretaton.

(11) a. Ringo-no ichibu-ga kusatteiru.
apple-GEN part-NOM is.rotten
'Part of the apple is rotten/Some of the apples are rotten.'
b. Ringo-no hotondo-ga kusatteiru.
apple-GEN most-NOM is.rotten
'Most of the apple(s) is/are rotten.'

The evidence discussed above indicates that in many languages proportional quantifiers are able to simultaneously access elements making up pluralities of individuals as well as subatomic part-whole structures. This suggests a unified part-whole structure for both plural and singular entities, contrary to what is typically assumed in mereological approaches to natural language. However, before drawing a conclusion let us look more closely at the discussed partitives.

4.2. Counterargument from the interaction with numerals

As observed by Schwarzschild (1996), nominal expressions such as *part* have different properties depending on whether they occur in partitive constructions with singular or plural DPs. Specifically, they are countable only if they refer to material parts of a singular object. For instance, the Italian phrase (12b) cannot be interpreted as referring to three subsets of the relevant set of the walls and can only have a meaning similar to (12a), i.e., denoting three material parts of the walls making up the plurality. This kind of behavior is cross-linguistically widespread.

(12) a. tre parti del muro
three parts of-the wall
'three parts of the wall'
b. #tre parti dei muri
three parts of-the walls
Intended: 'three subsets of the walls'

A possible consequence of the effect observed in (12) concerns the ontology encoded in the part of natural language semantics that deals with parthood. Specifically, what is implied by the evidence is that after all singularities and pluralities involve two distinct part-whole structures and it is just a coincidence that two different types of quantifiers happen to sound identically. Such an explanation would, of course, corroborate the recieved view in theories of parthood.

However, there is a good reason to believe that the phenomenon discussed in this section results from an independent factor. The extensions of regular plurals comprise arbitrary sums of individuals, i.e., scattered entities which bear no topological commitments with respect to the configuration of the parts of a plurality. It is well-known that numerals simply do not count pluralities and require the domain of quantification to consist only of singularities (e.g., Kratzer, 1989). Hence, (13a) is understood as referring to a plurality of three parts of the walls and not three pluralities of parts of the walls for the same reason why (13b) does not denote three pluralities of walls but rather a plurality of three walls. So, it turns out that partitives acctually pattern with regular nominals with respect to numeral modification.

(13) a. three parts of the walls
b. three walls

Furthermore, there is an intriguing twist corroborating the objection formulated above. What if there were a language with a plural that is similar to, say, the German plural in that it denotes sums of individuals but in addition it asserts a specific spatial relation holding between individuals making up a plurality that guarantees that such a sum has object-like properties? If the claim relating countability with being an integrated entity is on the right track, one would expect that when a partitive involving a proportional quantifier and such an untypical plural expression is modified by a numeral, the quantificational behavior of the whole phrase should differ from what we observed with respect to regular plurals. It turns out that such a construction can be found in Italian.

4.3. Italian irregular plurals

There is a relatively small set of irregular nouns in Italian that display both morpho-syntactic and semantic peculiarities with respect to the singular/plural distinction. These nouns form an inflectional class whose defining characteristic is that it exhibits an idiosyncratic agreement pattern involving a gender shift in the plural. Such forms are known as irregular plurals in *-a* (see Acquaviva, 2008 and references therein). The class of Italian irregular nouns can be divided into two groups. The first group consists of nouns that take irregular plural forms exclusively. More interestingly, however, there are also a number of nouns with both regular and irregular plural counterparts, see (14).[11]

(14) a. muro ∼ muri ∼ mura
wall$_{\text{SG.M}}$ wall$_{\text{PL.M}}$ wall$_{\text{PL.F}}$
'wall ∼ walls ∼ walls (in a complex)'

b. osso ∼ ossi ∼ ossa
bone$_{\text{SG.M}}$ bone$_{\text{PL.M}}$ bone$_{\text{PL.F}}$
'bone ∼ bones ∼ bones (in a skeleton)'

In the cases of doublets, concurrent irregular *-a* plurals tend to differ from run-of-the-mill *-i* forms in meaning. As witnessed by the translations of irregular forms in (14), there is often a sense of collectivity or cohesion in addition to the ordinary plural interpretation. For instance, the irregular form *ossa* 'bones' evokes an interpretation that the bones belong together as in a skeleton, whereas regular *ossi* 'bones' simply refers to a plurality of unrelated bones. Similar, the only way to interpret *mura* 'walls' is by picturing a walled complex, e.g., a perimeter of city walls. In both cases, there is a strong intuition that the referents of the irregular plural forms are naturally related and due to this kind of semantic flavor Italian *-a* plurals have been analyzed as collectivizers of a particular sort (Ojeda, 1995) or expressions inherently encoding the cohesion of referents (Acquaviva, 2008).

Therefore, it is plausible to posit that when an Italian plural in *-a* alternates with a regular *-i* form, its extension does not simply comprise arbitrary sums of individuals but rather a more complex type of entities. Specifically, I propose that the topological notion of connectedness or stable proximity of parts making up a plurality denoted by the irregular plural is involved in the way how the referents of such an expression are conceptualized. At least in some cases there is a good reason to assume that the reported collective flavor is due to the fact that Italian

[11] Acquaviva (2008: pp. 124–129) introduces a more subtle classification. For the sake of clarity of the main argument, I will not discuss all the nuanced morphological and semantic intricacies here.

irregular plurals encode integrated plural individuals, i.e., pluralities that unlike referents of regular plurals involve particular spatial relations holding between individual parts, and thus have the potential to form clusters, cohesive aggregates and even individuated wholes.

Italian is similar to many other languages in that it displays the same analogy as discussed in Section 4.1 with respect to singulars and regular plurals. Intriguingly, however, everything changes when a cardinal numeral modifies a partitive involving an irregular plural form such as those in (14). When an irregular doublet is swapped for a regular one, suddenly new interpretations are possible. For instance, similar to (12b) the phrase in (15a) refers to a plurality of three material parts but also it can be interpreted as denoting three subsets of the walls as long as individual walls form continuous sections. Similar, (15b) can refer either to three parts of the bones or to three continuous pluralities such as femur + knee, ulna + radius and skull + neck.

(15) a. tre parti delle mura
three parts of-the walls$_{\text{COLL}}$
'three parts of the complex formed by the walls'
b. tre parti delle ossa
three parts of-the bones$_{\text{COLL}}$
'three parts of the skeleton formed by the bones'

The evidence discussed above indicates that counting pluralities is possible only if they are conceptualized as topologically contiguous entities similar to units of some sort, a fact that a purely mereological treatment fails to capture. In the next section, I will present further evidence for the relevance of the topological notion of connectedness in partitive constructions.

4.4. Polish topology-sensitive proportional quantifiers

Polish distinguishes lexically between three morphologically related proportional quantifiers expressing the meaning *half*. As presented in (16), *pół* 'half$_2$' consists only of a root and a null inflectional marker, whereas *połowa* 'half$_1$' and *połówka* 'half$_3$' involve also additional morphology, i.e., the morpheme *-ow-/-ów-* marking the stem as well as the diminutive suffix *-k-* in the latter case.

(16) pół-∅ ∼ poł-ow-a ∼ poł-ów-k-a
root-infl.marker root-stem-infl.marker root-stem-suffix-infl.marker
all 'half'

At first sight, the expressions in (16) seem to be mere synonyms making the same contribution to the interpretation of a sentence. However, closer investigation reveals interesting differences in their distribution and meaning. Specifically, as witnessed in (17) there are no constraints on what the proportional quantifier *połowa* can combine with. On the other hand *pół* and *połówka* have a more restricted distribution since they are incompatible with cumulative predicates such as plurals and mass nouns and are only felicitous with count singulars. Furthermore, *połówka* prototypically combines with nominals denoting solid objects one could easily cut or divide into separate parts such as food terms or building materials like bricks.

(17) a. połowa / pół / połówka jabłka
half$_1$ half$_2$ half$_3$ apple$_{\text{GEN}}$
'half of the apple'

b. połowa / #pół / #połówka jabłek
half$_1$ half$_2$ half$_3$ apples$_{\text{GEN}}$
'half of the apples'

c. połowa / #pół / #połówka błota
half$_1$ half$_2$ half$_3$ mud$_{\text{GEN}}$
'half of the mud'

Based on the distributional differences presented above, it is plausible to assume distinct semantic properties of the discussed lexical items. In particular, the evidence suggests that *pół* and *połówka* require their arguments to denote integrated objects, and thus reject arbitrary sums and scattered entities.

Given that the only type of nominals that is compatible with all the proportional quantifiers in question is singular count nouns, let us explore in detail the meanings of the phrases in (17a). As already discussed in Section 3.3, parts need not be integrated. For instance, though the marked area in both Figure 1 and 2 constitute approximately 50% of the whole, only Figure 1 illustrates a continuous part. Intriguingly, it turns out that while *połowa jabłka* and *pół jabłka* are true of both Figure 1 and 2, *połówka jabłka* cannot denote an entity such as that depicted in Figure 2. Consequently, partitives with *połówka* refer only to integrated halves of an object denoted by the 'downstairs' DPs. Given the morphological complexity, I assume that the suffix *-k-* is responsible for introducing this constraint.

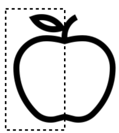

Figure 1: Continuous half

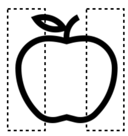

Figure 2: Discontinuous half

The novelty of the data introduced here is twofold. First of all, Polish proportional quantifiers provide strong evidence that natural language is sensitive to the topological arrangement of parts of an entity. Second, the evidence implies that individuation is also possible at the subatomic level, i.e., quantification over parts in natural language reflects the fact that some parts might be assigned the status of an individual in its own.

4.5. Multipliers

The final piece of evidence comes from an intriguing class of numerical expressions such as English *double* and *triple* which I will refer to as multipliers (following Quirk et al., 1985). Though such expressions display non-trivial semantic properties and constitute a crosslinguistically widespread category attested both within and outside the Indo-European, see (18)–(19), they have been surprisingly neglected in the formal study of quantification in natural language (but see Wągiel, to appear for an analysis of Slavic multipliers).

(18) a. double
b. doppio *Italian*
c. dvojnoj *Russian*
d. dvigubas *Lithuanian*

(19) a. dupla *Hungarian*
b. kaksinkertainen *Finnish*
c. kafúl *Hebrew*
d. shuāng *Mandarin*

Unlike cardinal numerals, multipliers do not count entities, but rather their particular parts.[12] For instance, consider examples such as those in (20).[13] Though object DPs in both (20a) and (20b) involve a quantifier, there is a crucial difference between the truth conditions of the two sentences. While (20a) is true if John ate a collection of two entities, (20b) does not require that John ate a plurality of objects. Rather, it is true if John ate one burger as along as it consisted of two particular parts, specifically two patties in a bun. In other words, while the cardinal simply counts entities denoted by the modified NP, the multiplier seems to quantify over elements within the inner structure of a denoted entity.

(20) a. John ate two burgers.
b. John ate a double burger.

The interpretative contrast discussed above indicates that *double* in (20b) restricts the denotation of the noun to only those burgers that have a particular complex form. Such an intuition seems to be further corroborated by the fact the fact that (21a) entails (21b). Thus, it is plausible to assume that multipliers trigger subatomic quantification or, in other words, are expressions dedicated to counting parts.

(21) a. The Burgenator is a double burger.
b. $\vDash$ The Burgenator consists of two parts.

Importantly, however, parts the multiplier quantifies over are not arbitrary. In fact, they appear to be the most salient parts of the whole entity. Intuitively, in the fast food context it is commonly assumed that in a way the essential element of a burger is a patty whereas other parts are considered to be merely a garnish. In extreme cases, such essential parts are what could be referred to as self-sufficient elements, i.e., parts that have a property very similar to the property of the whole entity. Many frequent collocates in the Corpus of Contemporary American English (COCA) fall into this category, e.g., *double bracket*, *double sink* and *double tomb*.

The fact that a certain part of an entity is perceived as significantly more salient than others corresponds to what is sometimes called structured parthood (Champollion and Krifka, 2016; see also Simons, 1987). On such an approach, certain parts might be viewed as more important than others or even essential for a particular individual. However, what counts as an essential part is somewhat vague and can be subject to different conceptualizations under different circumstances. To illustrate this claim, let us consider two more examples from the COCA collocate list for the English multiplier *double*, specifically *double arrow* and *double dagger*. One can stumble across the first in the context of typography where it can be used to designate the symbols $\Rightarrow$, $\leftrightarrow$ and $\gg$. Thus, what appears to be considered the most salient part, and thus multiplied, can be either the horizontal line or the arrowhead. Similar, in typography the phrase

[12]Though the distribution of multipliers is relatively broad, in this paper I will only focus on a subset of environments that are relevant with respect to the phenomena discussed here. For possible extensions, see Wągiel (2018, to appear).
[13]All burgers in the following examples are of course vegan.

double dagger refers to the symbol ‡. Its design indicates that the parts worth quantification over are the handles. However, in a military, martial arts, or gaming context the very same expression is much more likely to denote thrusting weapons with two blades.

Notice also that multipliers force individuation in such a way that the whole phrase is always countable. When a multiplier combines with a mass term, it triggers an obligatory shift into the count denotation, e.g., via the Universal Packager. For instance, similar to (22a) the phrase (22b) gets only a portion reading.

(22) a. two coffees
b. double coffee

Though many European languages borrowed their multipliers from Latin, in other languages multipliers and cardinals are formally related. For instance, Slavic multipliers are morphologically complex expressions derived from numeral roots by means of affixation which might be analyzed as encoding a classifier element. Similar patterns can be observed in Baltic and Finnic, as witnessed by the correspondences given in 1.

LANGUAGE	NUMBER	CARDINAL	MULTIPLIER
Russian	2	dva	dvojnoj
Lithuanian	2	du	dvigubas
Finnish	2	kaksi	kaksinkertainen

Table 1: Multipliers across languages

The morphological complexity of multipliers attested in some languages suggests that such expressions are semantically decomposable. Therefore, a proper treatment of multipliers not only should account for the discussed quantificational behavior but also it should involve a unified compositional mechanism allowing for derivation of both cardinals and multipliers.

4.6. Data summary

In Section 4.1 and 4.2, I have argued that the cross-linguistic distribution of proportional quantifiers in partitives indicates that singulars and plurals share a unified part-whole structure. The differences between the two types of expressions seem to stem from distinct ways in which topological notions play a role in their semantics. While singular count nouns can be viewed as encoding that their referents are integrated wholes, plurals denote collections of such entities but provide no information with respect to the topological relation holding between particular individuals. Crucially, numerals do not count such arbitrary sums and force the domain of quantification to consist of integrated wholes.

In Section 4.3, I discussed the evidence provided by Italian irregular plurals that indicates the existence of natural language expressions involving yet another type of structure. In particular, such nominals designate entities that are similar to plurals in that they consist of multiple integrated objects but at the same time the sum thereof is arranged in a particular way, i.e., it constitutes a cluster. The fact that when partitives involving such expressions are modified by numerals the resulting phrase can refer to a plurality of subsets as long as their members form a continuous configuration supports the claims presented in Section 3.

Moreover, in Section 4.4 I have presented novel evidence further corroborating the relevance of the notion of integrity in natural language. Specifically, certain Polish proportional quantifiers encode morphologically topological sensitivity. As a result, they require their arguments to denote integrated individuals or even constrain parts they yield to form continuous portions of matter.

Finally, in Section 4.5 I have discussed the relevance of the class of multipliers. I have argued that unlike cardinals, which quantify over wholes, multipliers are numerical expressions devised to count essential parts of wholes. Importantly, in both cases identical constraints on counting are imposed.

In the next section, I will demonstrate how at least some of the phenomena discussed here can be accurately captured by means of the mereotopological notions and assumptions concerning quantification introduced in Section 3.

5. Analysis

5.1. Singulars and plurals

In order to account for the data discussed in Section 4, I develop a mereotopological account on which singular count nouns are modeled as predicates of MSSC individuals, i.e., expressions encoding that the elements of their denotations are only MSSC entities, see (23). This allows us to capture the intuition that such expressions denote integrated wholes without employing the notion of atomicity.

(23) $[\![\text{apple}]\!] = \lambda x[\textsc{mssc}(\textsc{apple})(x)]$

On the other hand, in order to capture the meaning of regular plurals I propose that pluralization is modeled in terms of algebraic closure (Link, 1983) but also involves a special presupposition which requires the pluralized noun to be a predicate of MSSC entities, see (24).[14] In other words, parts of referents of regular plurals are required to be MSSC individuals but no additional topological constraints are imposed on pluralities thereof.

(24) a. $[\![\text{PL}]\!] = \lambda P \,.\, P_{\text{MSSC}}[{}^{*}P]$
b. $[\![\text{apples}]\!] = [\![\text{PL}]\!]([\![\text{apple}]\!]) = \lambda x\big[{}^{*}\big(\lambda y[\textsc{mssc}(\textsc{apple})(y)]\big)(x)\big]$

With the basic distinction between singulars and plurals, let us now move to the meaning of the two numerical expressions discussed in this paper.

5.2. Cardinals and multipliers

I propose that numerical expressions including cardinals and multipliers are complex semantic expressions derived from names of number concepts via different overt or covert classifiers specialized in counting distinct types of objects, e.g., MSSC entities and cognitively salient parts thereof, respectively.

I assume that cardinals are predicate modifiers (e.g., Ionin and Matushansky, 2006, Chierchia, 2010) derived by shifting numeral roots which I assume to be names of number concepts, i.e.,

[14]This formulation does not allow us to explain plural mass nouns. However, I will leave this issue for future research.

abstract entities of a primitive type n, by a classifier element $\text{CL}_{\#}$ which introduces an additive measure function $\#(P)$ which is standardized by the requirement in (25) (cf. Krifka, 1989). In essence, it maps MSSC individuals onto numbers.

(25) $\forall P \forall x[\#(P)(x) = 1 \text{ iff } \textsc{mssc}(P)(x)]$

Cardinal numerals are modeled as expressions that take predicates of MSSC individuals and yield sets of pluralities consisting of a particular number of MSSC entities. That number corresponds to the meaning of a numeral root, see, e.g., (26). Notice also that I assume that cardinals trigger pluralization and I take plural forms of modified nominals in languages such as English to be due to semantic agreement.

(26) $[\![\text{two}]\!] = [\![\text{CL}_{\#}]\!]([\![\sqrt{\text{tw}}]\!]) = \lambda P.\ P_{\text{MSSC}}\ \lambda x[{}^{*}P(x) \wedge \#(P)(x) = 2]$

I assume that multipliers, similar to cardinals, are semantically complex expressions. As discussed in Section 4.5, in some languages their decomposability is indicated by their morphology, i.e., they are derived from numeral roots. I propose that multipliers are also predicate modifiers but unlike cardinals they do not involve a classifier dedicated to counting integrated wholes but rather an element $\text{CL}_{\boxplus}$ which is specialized in counting essential parts of objects. This is ensured by the measure function $\boxplus(P)$ which satisfies the requirement specified in (27).

(27) $\forall P \forall x[\boxplus(P)(x) = 1 \text{ iff } \textsc{mssc}(P)(x) \wedge \exists y[y \sqsubseteq x \wedge \textsc{essential}(P)(y) \wedge \#(y) = 1]]$

Similar to cardinals, multipliers take as their input a set of MSSC entities and yield its subset such that it consists of those MSSC individuals that involve a particular number of essential parts, see (28) for the Russian multiplier *dvojnoj* 'double'. Notice that multipliers do not involve pluralization, and thus a resulting phrase can be modified by a cardinal numeral.

(28) $[\![\text{dvojnoj}]\!] = [\![\text{CL}_{\boxplus}]\!]([\![\sqrt{\text{dv}}]\!]) = \lambda P.\ P_{\text{MSSC}}\ \lambda x[P(x) \wedge \boxplus(P)(x) = 2]$

The proposed mechanism provides a unified algorithm to derive different types of numerical expressions by combining names of number concepts with different kinds of classifiers. Let us now turn to the semantics of various partitives.

5.3. Partitives

Following Barker (1998), I model partitivity in terms of proper parthood. However, the main difference is that in the discussed partitive constructions I locate the source of partitivity not in a preposition such English *of* but rather in proportional quantifiers themselves. In general, I assume the meaning of a partitive expression such as *part* as in (29a). For quantifiers such English *half*, I postulate a generalized context-dependent measure function μ similar to *more* in the system by Bale and Barner (2009). Given a proper ordering of measure functions, the mechanism of contextual conditioning ensures that μ gives different measures for different DPs, specifically either volume for singulars or number for plurals. The denotation of proportional quantifiers such as *half* is provided in (29b).

(29) a. $[\![\text{PART}]\!] = \lambda y \lambda x[x \sqsubset y]$
b. $[\![\text{HALF}]\!] = \lambda y \lambda x[x \sqsubset y \wedge \mu(x) \approx \mu(y) \times 0.5]$

In order to account for topology-sensitive proportional quantifiers, I posit that two ingredients are required, namely non-overlap and integrity. Non-overlap can be ensured by the partitioning function π which when applied to a set guarantees that given a particular context all members of the resulting subset are disjoint, see (30).

(30) For any P and any x and y in $\pi(P)$: $\neg\exists z[z \sqsubseteq x \wedge z \sqsubseteq y]$ relative to a particular context.

However, since non-overlap is insufficient, disjoint parts need to be individuated by imposing the integrity condition. I propose that this is achieved by the individuating element IND which gets rid off those non-overlapping parts that are discontinuous by introducing the MSSC condition, see (31). Though IND is often null, it can have a formal exponent, as indicated by the data discussed in Section 4.4.

(31) $[\![\text{IND}]\!] = \lambda P \lambda x[\textsc{mssc}\big(\pi(P)\big)(x)]$

With these tools, I propose the semantics for different types of proportional quantifiers. For instance, German topology-neutral partitive expression *Teil* ‘part’ simply gets the interpretation in (32a). The semantics of Polish topology-neutral *połowa* ‘half’ differs only in that it specifies that the resulting part constitutes approximately 50% of the whole, see (32b). On the other hand, Polish topology-sensitive *pół* ‘half’ involves a special presupposition ensuring that it only combines with a DP denoting an MSSC individual, see (32c). This explains why it is incompatible with plurals and mass terms. Furthermore, I posit that the suffix *-k-* in Polish proportional quantifiers is an exponent of IND, see (32d) which allows to derive the individuating proportional quantifier *połówka* ‘half’, see (32e). Thus, *połówka* can only combine with a DP denoting an MSSC entity and always yields a continuous half of such an object.

(32) a. $[\![\text{Teil}]\!] = \lambda y \lambda x[x \sqsubset y]$
b. $[\![\text{połowa}]\!] = \lambda y \lambda x[x \sqsubset y \wedge \mu(x) \approx \mu(y) \times 0.5]$
c. $[\![\text{pół}]\!] = \lambda y\ .\ y_{\text{MSSC}}\ \lambda x[x \sqsubset y \wedge \mu(x) \approx \mu(y) \times 0.5]$
d. $[\![\text{-k-}]\!] = [\![\text{IND}]\!] = \lambda P \lambda x[\textsc{mssc}\big(\pi(P)\big)(x)]$
e. $[\![\text{połówka}]\!] = [\![\text{-k-}]\!]([\![\text{pół DP}]\!])$

The proposed denotations allow us to derive the meanings of different types of partitives via standard function application. Extending the repertoire of formal tools with the mereotopological notion of MSSC accompanied with several additional assumptions provides means to explain the so-far neglected issues in subatomic quantification.

6. Conclusion

The main aim of this paper was to contribute to our understanding of quantification in natural language by exploring the so far neglected domain of subatomic quantification, i.e., quantification over parts of building blocks of the denotations of singular count nouns. I have provided compelling evidence for the relevance of this phenomenon for natural language semantics. In particular, I have explored various aspects of meaning of a broad range of linguistic expressions such as different types of partitive constructions including partitives with Italian irregular plurals as well as multipliers such English *double* from a cross-linguistic perspective. Properties of different types of investigated expressions suggest that there is one unified parthood relation for various types of entities and different part-whole structures result from distinct topological relations holding between particular elements such as integrity or lack thereof. Furthermore, the existence of topology-sensitive proportional quantifiers in Polish demonstrates the relevance of the notion of integrity in quantification in natural language. In order to account for the data, I proposed a universal mechanism which allows for counting of both entire objects and their parts. Its formal implementation is based on mereotopology, i.e., a theory which extends standard mereological parthood with topological notions such as connectedness. Different aspects of meanings can arise as a result of the interaction between topology, partitivity and numerical quantification.

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The temporal orientation of infinitives [1]

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Abstract. In this paper, we present a compositional semantics for a covert future operator which derives the distribution of future oriented infinitival complements to attitude predicates. We then show that the account makes correct predictions concerning the temporal orientation of prejacents to modal auxiliaries.

Keywords: infinitival tense, attitude predicates, covert future.

1. Introduction

1.1. Three types of infinitive

There are three attested temporal orientations of infinitival complements to attitude predicates: (i) obligatorily simultaneous, where the event time of the embedded clause is understood to overlap with the event time of the matrix clause (1a), (ii) obligatorily future oriented, where the embedded event time is understood to follow the matrix event time (1b), or (iii) optionally future oriented, where the embedded event time is typically understood to follow the matrix event time, although under certain conditions they may also be understood to overlap (1c).

(1) a. Mikhail {claimed/pretended/was glad/believed Judit} to be at the party.
    b. Mikhail {promised/asked/ordered Judit} to be at the party.
    c. Mikhail {hoped/expected/wanted} to be at the party.

Abusch (2004) noted this trifurcation for passive ECM constructions of the form *x is V-ed to P*. She called the verbs in each class: B-verbs, F-verbs, and P-verbs respectively (the following judgments reflect Absuch's classification).[2]

(2) a. Judit is believed to be at the party ({already/*tomorrow}).
    b. Judit is forecast to be at the party ({tomorrow/*already}).
    c. Judit is predicted to be at the party ({tomorrow/already}).

Yet, despite insights such as those of Katz (2001), Abusch (2004), von Stechow (2005), Wurmbrand (2014), and others, Portner (2018) notes that work on the temporal orientation of infinitives is still fragmentary. Additionally, the majority of work on infinitival tense is primarily concerned with the status of the infinitival subject (i.e., PRO, trace, or ECM subject), with only secondary interest in temporality (e.g., Stowell, 1982; Pesetsky, 1992; Landau, 2000; Martin, 2001; Grano, 2015; Pearson, 2016). The present paper puts the question of the infinitival subject aside and aims to solely address the data in (1) and (2).

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[2] Abusch called F-verbs as such because she took the predicate *forecast* to typify these verbs. However, for most people *forecast* seems to behave much like *predict* in permitting simultaneous readings (i).

(i) A: What is the weather like outside?
    B: It is forecast to be raining.

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1.2. Two types of approaches

In the cases above (1)-(2), the infinitival complements themselves are ostensibly identical. There have largely been two ways to go about handling this disparity between surface form and interpretation: (i) positing a covert future operator (e.g., Abusch, 2004; von Stechow, 2005; Wurmbrand, 2014; Grano, 2015) as in (3), or (ii) building it into the selecting verbs lexical semantics (Katz, 2001; Pearson, 2016) as in (4).

(3) $[\![\text{FUT}]\!]^{w,t} = \lambda p.\ \exists t' > t : [\![p]\!]^{w,t'} = 1$

(4) $[\![\text{expect}_{Katz\ (2001)}]\!]^{w,t} = \lambda p.\lambda x.\ \forall \langle w', t' \rangle \in \text{Dox}_{w,t,x} : \exists t'' > t' : [\![p]\!]^{w',t''} = 1$

Both Abusch (2004) and Williamson (2017) argue explicitly in favor of something like (3). However, proposals of this sort need to account for the distribution of the putative future operator. How can its distribution be restricted to give us the observed data? Wurmbrand (2014), Grano (2015), and Williamson (2017) treat the future operator as a covert instantiation of *woll*, the abstract future modal underlying present tense *will* and past tense *would* (Abusch, 1998). However, this raises a number of questions: firstly, why can an overt *woll* appear in finite complements to predicates like *believe* and *claim* but a covert *woll* cannot occur in infinitival complements to the same predicates? Secondly, why is it that infinitival complements to predicates like *expect* feature a covert *woll* but not, for instance, a covert deontic *must*?

(5) Mikahil expected to tidy his room.
  a. $\approx$ Mikhail expected he would tidy his room.
  b. $\not\approx$ Mikhail expected he must tidy his room.

Here, we will assume that the future operator is dissociated from modal auxiliaries (Matthewson, 2012; Giannakidou and Mari, 2018) but may be licensed in their scope. Infinitival complements cannot license modal auxiliaries (Stowell, 2004; Iatridou and Zeijlstra, 2013) and as a result the semantics of the selecting verb itself is responsible for the licensing of the future operator. To achieve the observed distribution of future oriented infinitives, we argue that the future operator carries a presupposition that the modal context – introduced below – is diverse with respect to the future oriented proposition. We also suggest that an obligatorily future oriented reading is necessary for the verbs discussed above due to the notion of intention to act (Grano, 2017b). The resulting picture is that the distribution of future orientation in infinitival complements is dictated by the modal force and flavor of the embedding verb. We further note that these generalisations hold equally for the temporal orientation of prejacents to different types of modal auxiliaries.

In the next section, we outline the background assumptions necessary to formulate our proposal.

2. Kratzerian modal semantics and some extensions

2.1. The modal base and the ordering source

Kratzer (1977, 1981, 2012) develops a doubly relativized theory of modality, which makes use of two contextually determined *conversational backgrounds* (a function from worlds, times, and potentially individuals to a set of propositions). The first relevant conversational background is the *modal base* function f which returns a set of propositions which, when intersected, provides a set of accessible worlds.

(6) $[\![\text{must } \varphi]\!]^{w,t,f} = 1$ iff $\forall w' \in \bigcap f(w)(t) : [\![\varphi]\!]^{w',t} = 1$

A theory of modality with only a modal base runs in to some well-known problems providing truth conditions for deontic statements like that in (7).

(7) The person who killed Mikhail must go to prison.

It is tempting to assume that, in (7), the relevant propositions returned by f are those that make up the law.[3]

(8) a. $[\![(7)]\!]^{w,t,f} = 1$ iff $\forall w' \in \bigcap f(w)(t) : \left[\!\!\left[\begin{array}{c} \text{the person who killed Mikhail} \\ \text{goes to prison} \end{array} \right]\!\!\right]^{w',t} = 1$

b. where $f(w)(t) = \text{LAW}_{w,t} = \{p \mid p \text{ is a law in } w \text{ at } t\}$

However, the prejacent *the person who killed Mikhail goes to prison* (Strawson) entails that Mikhail was killed. If the law entails the person who killed Mikhail goes to prison, then the law also entails Mikhail was killed (!). So, the following inference is predicted to hold.[4]

(9) The person who killed Mikhail must go to prison.
$\not\Rightarrow$ Mikhail must have been killed.

Kratzer's solution is to suggest that deontic modals rank accessible worlds according to how well they satisfy, for example, the law. But the only worlds considered are those compatible with the circumstances (e.g., worlds in which Mikhail has been murdered). Deontic modals, then, have a *circumstantial* modal base, and the worlds in the modal base are ranked according to a second conversational background: the *ordering source*. We pick out the best worlds in the modal base (MB) according to the ordering source (OS) with the operator MAX (von Fintel, 1999; von Fintel and Heim, 2011).

(10) a. $\text{MAX}_{\text{OS}}(\bigcap \text{MB}) = \{w \in \bigcap \text{MB} \mid \neg\exists w' \in \text{MB} : w' \prec_{\text{OS}} w\}$

b. where $w' \prec_{\text{OS}} w$ iff $\{p \in \text{OS} \mid [\![p]\!]^{w} = 1\} \subset \{p \in \text{OS} \mid [\![p]\!]^{w'} = 1\}$

We can now propose a revised semantics for (7) (where g is the ordering source function).

(11) a. $[\![(7)]\!]^{w,t,f,g} = 1$ iff $\forall w' \in \text{MAX}_{g(w)(t)}(\bigcap f(w)(t))$:
$[\![\text{the person who killed Mikhail goes to prison}]\!]^{w',t} = 1$

b. where $f(w)(t) = \text{CIRC}_{w,t} = \{p \mid p \text{ is a fact in } w \text{ at } t\}$

c. and $g(w)(t) = \text{LAW}_{w,t}$

These new truth conditions require that, given the facts, all the most law-abiding worlds are such that the person who killed Mikhail goes to prison. While this is intuitively a more appropriate semantics for (7), given (11), we should still be able to draw the undesirable inference in (9). Since all the worlds in the modal base are worlds in which there are murderers, it follows that in the best worlds there are murders. This issue is resolved by assuming that, whenever a modal has an ordering source, the modal base must be diverse with respect to the prejacent. (i.e., it must contain φ and $\neg\varphi$ worlds). This ensures that the restriction on the domain of quantification imposed by the ordering source is not redundant.

[3]We will use all uppercase letters for a set of propositions, and a mix of upper and lowercase for its intersection (e.g., $\text{Dox}_{w,t,x} = \bigcap \text{DOX}_{w,t,x}$).

[4]That this inference is predicted, yet does not hold, is known as the Paradox of the Good Samaritan (Prior, 1958).

2.2. Attitude predicates

Since Hintikka (1969) the verb *believe* is generally assumed to be a universal quantifier over doxastically accessible worlds (those worlds compatible the attitude holder's beliefs).

(12) $[\![\alpha \text{ believe } \varphi]\!]^{w,t} = 1$ iff $\forall w' \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w',t} = 1$

However, if we treat bouletic predicates such as *want* in a manner similar to *believe*, we encounter the same type of problem observed for deontic modals above (Stalnaker, 1984; Heim, 1992).

(13) a. I believe Judit will get better.
$\Rightarrow$ I believe Judit is sick.
b. I want Judit to get better.
$\not\Rightarrow$ I want Judit to be sick.

von Fintel (1999) proposes an ordering semantics for bouletic predicates, and a diversity requirement on the modal base of the attitude. The following semantics for *hope* is von Fintel's. The modal base is the doxastic alternatives of the attitude holder, and the ordering source is the propositions which constitute the desires of the attitude holder.

(14) $[\![\alpha \text{ hopes } \varphi]\!]^{w,t} =$
a. defined iff $\exists w' \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w',t} = 1 \land \exists w'' \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w'',t} = 0$
b. if defined, $= 1$ iff $\forall w''' \in \text{MAX}_{\text{DES}_{w,t,\alpha}}(\text{Dox}_{w,t,\alpha}) : [\![\varphi]\!]^{w''',t} = 1$

On this semantics, *hope* φ presupposes that the attitude holder is uncertain whether φ, thereby avoiding the undesireable Stalnaker/Heim inferences in (13b), while asserting that φ is true in all the most desirable belief worlds.

2.3. Modal contexts

In addition to the above, we will adopt the notion of a *modal context*. It has been proposed that certain operators are sensitive to an additional parameter S on the denotation assignment function which relativizes the function to a set of worlds. The most notable items of this sort are epistemic modals (see Yalcin, 2007; Anand and Hacquard, 2013).[5] We will call such a parameter the *modal context* (Portner, 1992).[6] Crucially, the modal context can be shifted by various modal operators. We propose that modal operators shift the modal context to their modal base.[7]

(15) $[\![\alpha \text{ believe } \varphi]\!]^{w,t,S} = 1$ iff $\forall w' \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w',t,\text{Dox}_{w,t,\alpha}} = 1$

This essentially ensures that the modal base of an attitude predicate is accessible to certain operators in the clause embedded directly under it.

[5]See also Portner (2018) for a recent overview of this idea.
[6]We will also use this term to refer to the environment which is interpreted against this parameter: corresponding to the immediate syntactic scope of the modal operator.
[7]There may be an additional need for a second modal context which tracks the ordering source in some way. Such a modal context could play a role in accounting for mood selection.

3. Defining the future

The focus of this paper is on, what we will call, the *contingent future* which is typically used in predictive contexts and is generally introduced by the modal auxiliary *will* in English finite clauses.

(16) The Red Sox will win tomorrow.

This is in contrast to to the *scheduled future* which looks morphologically like the simple present, or the present progressive (17a). This type of future can only be used when describing states of affairs which are in some sense planned (cf. (17b)) (see Copley, 2009, 2008).

(17) a. The Red Sox {play/are playing} tomorrow.
b. #The Red Sox {win/are winning} tomorrow.

In order to provide a semantics for the contingent future which will derive the observed phenomena, it is worth considering what it means for a future state of affairs to be contingent. Contingency should be defined with respect to a set of possible worlds X. Informally, a future state of affairs is contingent wrt X iff there are worlds in X for which there is a future time at which the state of affairs holds and there are worlds in X for which there is no future time at which the state of affairs holds. To capture this intuition, we need to make our modal contexts more fine-grained. We treat modal operators (e.g., *believe*) as quantifying not just over worlds, but rather over world-time pairs. Where the temporal variable corresponds to the attitude holder's (e.g., doxastic) candidate for NOW (Abusch, 1998: a.m.o). The evaluation time of an infinitival complement is bound by the temporal coordinate quantified over by the selecting verb (Schlenker, 1999; Katz, 2001; Stephenson, 2007; Pearson, 2016).

(18) $[\![\alpha \text{ believe } \varphi]\!]^{w,t,S} = 1 \text{ iff } \forall \langle w',t'\rangle \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w',t',\text{Dox}_{w,t,\alpha}} = 1$

We can now propose a future operator like (3) above but with a contingency presupposition where the relevant set of worlds with respect to which the proposition is contingent is the local modal context.

(19) $[\![\text{FUT}(p)]\!]^{w,t,S} =$
a. defined iff $\exists \langle w',t'\rangle \in S : \exists t'' > t' : [\![p]\!]^{w',t''} = 1$
$\wedge\ \exists \langle w',t'\rangle \in S : \neg\exists t'' > t' : [\![p]\!]^{w',t''} = 1$
b. if defined, $= 1$ iff $\exists t' > t : [\![p]\!]^{w,t'} = 1$

With this semantics for the contingent future operator FUT, let us see what distribution we derive with infinitival complements to attitude predicates based on standardly assumed denotations for these predicates.

4. Simultaneous predicates

Recall that the following predicates are unable to embed a future oriented infinitive (where *be glad* is representative of the entire class of emotive factives).

(20) $\text{*Mikhail} \left\{ \begin{array}{c} \text{believed Judit} \\ \text{claimed} \\ \text{pretended} \\ \text{was glad} \end{array} \right\} \text{to win the match tomorrow.}$

4.1. *Believe*

Given a Hintikkan semantics for *believe*, it should be clear that if its complement φ is of the form $\mathrm{FUT}(p)$, then the presupposition of the future operator will contradict the assertion.[8]

(21) $[\![\alpha \text{ believes FUT}(p)]\!]^{w,t,S} =$
  a. defined iff $\exists\langle w',t'\rangle \in \mathrm{Dox}_{w,t,\alpha} : \exists t'' > t' : [\![p]\!]^{w',t'',\mathrm{Dox}_{w,t,\alpha}} = 1$
  $\wedge\ \exists\langle w',t'\rangle \in \mathrm{Dox}_{w,t,\alpha} : \neg\exists t'' > t' : [\![p]\!]^{w',t'',\mathrm{Dox}_{w,t,\alpha}} = 1$
  b. if defined, $= 1$ iff $\forall\langle w',t'\rangle \in \mathrm{Dox}_{w,t,\alpha} : \exists t'' > t : [\![p]\!]^{w',t'',\mathrm{Dox}_{w,t,\alpha}} = 1$

This sort of systematic contradiction has been proposed to result in ungrammaticality (Gajewski, 2002, 2009; Chierchia, 2013; Abrusán, 2014).[9] We thus derive the fact that *believe* will be ungrammatical when embedding a future oriented infinitive, as the sentence can never be defined and true.

4.2. *Claim*

Anand and Hacquard (2009) give an event semantics for *claim* φ, in which *claim* is taken to consist of an asserting event, with the goal of updating the *common ground* (Stalnaker, 1978) with φ. Putting aside event semantics, we might propose something along the lines of (22).

(22) $[\![\alpha \text{ claims } \varphi]\!]^{w,t,S} = 1$ iff α says $\varphi \wedge \forall w' \in \mathrm{Goals}_{w,t,\alpha} :$
  $\forall\langle w'',t''\rangle \in \bigcap \mathrm{CG}_{w'} : [\![\varphi]\!]^{w'',t'',\bigcap \mathrm{CG}_{w'}} = 1$

If φ in (22) is of the form $\mathrm{FUT}(p)$, then the presupposition would be such that the set of worlds compatible with the common ground ($\bigcap$CG) in α's goal worlds is diverse with respect

[8]The presupposition of FUT must project out of attitude contexts or else we make a weaker prediction that the attitude holder has an inconsistent belief (Patrick Elliot, pc). We propose that the presupposition of the contingent future is akin to presuppositions triggered by (e.g., gender) features in that they project out of attitude environments. An interesting possibility is that there is only one future operator, which carries either a CONTINGENT feature or SCHEDULED feature. The present proposal could then be seen as defining the semantics for the CONTINGENT feature.

[9]Perhaps the best known account of this sort is that of Gajewski (2002, 2009) and his notion of L(ogical)-Analyticity. The account can be summarized as follows.

(i) *L-Analyticity*
  a. A sentence is ungrammatical if its LF contains a L-analytic constituent.
  b. A constituent α of type t is L-analytic iff α's logical skeleton receives the denotation 1 (or 0) under every variable assignment for which it is defined.
  c. where α's logical skeleton is determined by the process of
    i. Identifying the maximal constituents containing no permutation invariant items (van Bentham, 1989).
    ii. Replacing each such constituent with a distinct variable of the same type.

Adopting an account of this type will require syntactic decomposition of attitude predicates in order to ensure the relevant parts are permutation invariant (see Theiler et al., 2018). A Hintikkan attitude predicate selects a modal base accessibility function $\mathcal{M}$ as an argument (ii). A predicate with an ordering source takes an additional ordering source argument $\mathcal{O}$ (iii).

(ii) a. $[\![\mathcal{M}_{\mathrm{Dox}}]\!]^{w,t} : \langle e,\langle i,st\rangle\rangle = \lambda x.\ \mathrm{Dox}_{w,t,x}$
  b. $[\![\mathrm{PRED}]\!]^{w,t} = \lambda\mathcal{M}.\lambda p.\lambda x.\ \forall\langle w',t'\rangle \in \mathcal{M}(x) : [\![p]\!]^{w',t',\mathcal{M}(x)} = 1$

(iii) a. $[\![\mathcal{O}_{\mathrm{DES}}]\!]^{w,t} : \langle e,\langle\langle i,st\rangle,t\rangle\rangle = \lambda x.\ \mathrm{DES}_{w,t,x}$
  b. $[\![\mathrm{PRED_{OS}}]\!]^{w,t} = \lambda\mathcal{M}.\lambda\mathcal{O}.\lambda p.\lambda x.\ \forall\langle w',t'\rangle \in \mathrm{MAX}_{\mathcal{O}(x)}(\mathcal{M}(x)) : [\![p]\!]^{w',t',\mathcal{M}(x)} = 1$

For the sake of simplicity we suppress these syntactic complications in the main text.

to $\mathrm{FUT}(p)$. The second conjunct of the assertion, however, would require that $\bigcap$CG in α's goal worlds is uniform with respect to $\mathrm{FUT}(p)$.

4.3. *Be glad* and emotive factives

The emotive factive *be glad* has a preference semantics, and so should have a diversity condition on its modal base. However, *be glad* also presupposes belief (Schlenker, 2003). That is, α *is glad that* φ presupposes α believes that φ. This presupposition can be seen to project in entailment cancelling environments (e.g., the *family-of-sentences* paradigm (Chierchia and McConnell-Ginet, 1990; Tonhauser et al., 2013)).

(23) a. Mikhail is not glad that Judit won.
b. If Mikhail is glad that Judit won, he will buy her a present.
c. Is Mikhail glad that Judit won?

The modal base of emotive factives, then, cannot be doxastic (or else the presupposition of *be glad* will always result in a contradiction). Rather, the modal base of *be glad* must be a superset of the doxastic alternatives which includes some $\neg\varphi$ worlds. The important point for our purposes is that *be glad* will not be able to embed $\mathrm{FUT}(p)$ due to the following definedness conditions.

(24) $[\![\alpha \text{ is glad } \mathrm{FUT}(p)]\!]^{w,t,S} = \text{defined iff } [\![\alpha \text{ believes } \mathrm{FUT}(p)]\!]^{w,t,S} \text{ is defined} \wedge [\![\alpha \text{ believes } \mathrm{FUT}(p)]\!]^{w,t,S} = 1 \wedge ...$

This says that *be glad FUT(p)* can only be defined when *believe FUT(p)* is defined and true. As we have seen above this condition can never be met.

At first, the emotive factive *be excited* appears to be a counterexample to the above generalisation. It is factive, and yet individuals are typically excited about future events. However, note that infinitival complements to *be excited* can only be about the future when the complement involves a scheduled event.

(25) a. Judit is excited to {meet/be meeting} Mikhail later.
b. *Judit is excited to {win/be winning} the match tomorrow.

Thus, even the apparently problematic *be excited* obeys the generalisation that emotive factives are unable to embed the contingent future, as predicted by the present proposal.

4.4. *Pretend*

The verb *pretend* similarly cannot embed future oriented infinitives (Pearson, 2016). The explanation for this is similar in nature to that for emotive factives. However, this verb presupposes that the attitude holder believes the complement to be false: the doxastic alternatives of the attitude holder are uniform with respect to $\neg\varphi$. As such, when it embeds $\mathrm{FUT}(p)$, it will have the definedness conditions in (26), which can never be satisfied.

(26) $[\![\alpha \text{ pretends } \mathrm{FUT}(p)]\!]^{w,t,S} = \text{defined iff } [\![\alpha \text{ believes } \neg(\mathrm{FUT}(p))]\!]^{w,t,S} \text{ is defined} \wedge [\![\alpha \text{ believes } \neg(\mathrm{FUT}(p))]\!]^{w,t,S} = 1 \wedge ...$

In contrast, consider *wish*. When *wish* takes a finite complement it presupposes that the attitude holder believes the complement to be false.

(27) Mikhail wishes he could travel to Paris next year.
$\Rightarrow$ Mikhail believes he can't travel to Paris next year.

However, when it takes a non-finite complement, this counterfactivity disappears (likely due to the lack of counterfactual morphology in its complement).

(28) Mikhail wishes to travel to Paris next year.
$\not\Rightarrow$ Mikhail believes he won't travel to Paris next year.

Since *wish+to* lacks a counterfactual presupposition, we correctly predict that infinitival complements to *wish* need not be obligatorily simultaneous, as can be seen in (28).

5. Optionally future oriented predicates

Let us turn our attention to the optionally future oriented predicates *want*, *hope*, and *expect*. The presuppositions of these predicates not only account for their possible future orientations, but also constrain the conditions under which they can embed simultaneous infinitives (Banerjee, 2017; Williamson, 2017).

5.1. *Hope* and *expect*

The following is based on von Fintel's (1999) semantics for *hope*.

(29) $[\![\alpha \text{ hopes } \varphi]\!]^{w,t,S} =$
a. defined iff $\exists\langle w',t'\rangle \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w',t',\text{Dox}_{w,t,\alpha}} = 1 \wedge$
$\exists\langle w'',t''\rangle \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w'',t'',\text{Dox}_{w,t,\alpha}} = 0$
b. if defined, $= 1$ iff $\forall\langle w''',t'''\rangle \in \text{MAX}_{\text{DES}_{w,t,\alpha}}(\text{Dox}_{w,t,\alpha}) : [\![\varphi]\!]^{w''',t''',\text{Dox}_{w,t,\alpha}} = 1$

The presupposition of this verb ensures that the modal base is diverse wrt φ, while the assertive content involves quantification over a subset of the modal base (the most desirable doxastic alternatives). Given this semantics, *hope* is correctly predicted to be able to embed FUT.

As for the verb *expect*, Katz (2001) proposes a semantics as follows (repeated from (4), where the quantification over future times is built into the verb.

(30) $[\![\text{expect}_{\textit{Katz (2001)}}]\!]^{w,t} = \lambda p.\lambda x.\ \forall\langle w',t'\rangle \in \text{Dox}_{w,t,x} : \exists t'' > t' : [\![p]\!]^{w',t''} = 1$

Conversely, Williamson (2017) argues that *expect* has a semantics more or less identical to *hope* modulo replacing the bouletic ordering source with one of likelihood.

(31) $[\![\alpha \text{ expects } \varphi]\!]^{w,t,S} =$
a. defined iff $\exists\langle w',t'\rangle \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w',t',\text{Dox}_{w,t,\alpha}} = 1 \wedge$
$\exists\langle w'',t''\rangle \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w'',t'',\text{Dox}_{w,t,\alpha}} = 0$
b. if defined, $= 1$ iff $\forall\langle w''',t'''\rangle \in \text{MAX}_{\text{LIKELY}_{w,t,\alpha}}(\text{Dox}_{w,t,\alpha}) : [\![\varphi]\!]^{w''',t''',\text{Dox}_{w,t,\alpha}} = 1$

Evidence for this affinity between *hope* and *expect* comes in several forms. Most notably, their doxastic uncertainty requirements can be seen in examples like the following (cf. *want*), based on Scheffler (2008). If the attitude holder believes either φ or $\neg\varphi$, then it is infelicitous to expect or hope φ. This is straightforwardly accounted for if *expect*, like *hope*, has a doxastic uncertainty requirement.

(32) A: It is raining.
B: I want it to be / That is what I want.
C: #I hope it is / I expect it to be.

(33) A: It is raining.
B: I want it not to be / That is not what I want.
C: #I hope it isn't / I expect it to not be.

Furthermore, these predicates both asymmetrically embed epistemic modals (Anand and Hacquard, 2013). They may embed epistemic possibility modals, but not epistemic necessity modals (see Williamson (2017: fn.11) for a formalisation of how to capture this with a von Fintel-style semantics). The most suggestive evidence, however, is that English *hope* and *expect* are translated as one and the same verb in several Romance languages (e.g., *esperar* in Spanish). We can capture this by fixing the modal base, while the ordering source is partially determined by a conversational background supplied by g.

(34) $[\![\alpha \text{ esperar } \varphi]\!]^{w,t,g,S} =$
a. defined iff $\exists\langle w',t'\rangle \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w',t',\text{Dox}_{w,t,\alpha}} = 1 \wedge$
$\exists\langle w'',t''\rangle \in \text{Dox}_{w,t,\alpha} : [\![\varphi]\!]^{w'',t'',g,\text{Dox}_{w,t,\alpha}} = 0$
b. if defined, $= 1$ iff $\forall\langle w''',t'''\rangle \in \text{MAX}_{g(w)(t)(\alpha)}(\text{Dox}_{w,t,\alpha}) : [\![\varphi]\!]^{w''',t''',g,\text{Dox}_{w,t,\alpha}} = 1$

With this semantics for *expect*, it is no surprise that it too can embed future oriented infinitives. Interestingly, this semantics also constrains the distribution of simultaneous infinitival complements to these verbs. Pesetsky (1992) notes that *expect* can embed a simultaneous ECM complement and when it does it means something akin to *believe but not know*.[10]

(35) I expect there to be flowers on the table.

Abusch (2004) makes a similar observation for *predict* in passive ECM constructions.

(36) Judit is predicted to be pregnant.

Williamson (2017) shows that *expect* and *hope* can embed simultaneous complements only when their doxastic uncertainty requirement holds. This is more likely to be the case with ECM complements (for *expect* or *predict*). However, control complements can also be interpreted simultaneously given the appropriate context.[11]

(37) SCENARIO: *Judit is running for office. She has not viewed the polls, nor has she heard any news. Mikhail asks her how she thinks she is doing. She replies*
a. I {hope/expect} to be winning (already).
b. I {hope/expect} to have won by a landslide (by now).

[10]While our semantics does not correspond exactly to Pesetsky's informal characterization, it is analogous.

[11]Williamson (2017) suggests that, due to PRO's interpretation *de se* (Chierchia, 1989), the uncertainty requirement is easier to fulfil with an ECM complement than with a control complement. It is intuitively less common for an individual to be uncertain whether a property currently holds of herself, while she can often be uncertain whether such a property holds of another individual, or herself at a future time.

A similar observation for simultaneous subjunctive complements to *esperar* is found in Laca (2015).

5.2. *Want*

That *want* has on ordering semantics, and can embed FUT is not surprising. What is perhaps more interesting is how it differs from the verb *hope*. In contrast to *hope*, *want* has often been argued to lack a doxastic component (Anand and Hacquard, 2013), or to have a modal base which is a superset of the doxastic alternatives, containing some non-belief worlds (Rubinstein, 2017). Unlike *hope*, this allows *want* to embed a proposition which the attitude holder believes to be impossible (Heim, 1992) (38a), or true (38b) (Iatridou, 2000).

(38) a. I want this weekend to last forever.
b. I live in Bolivia because I want to live in Bolivia.

It is thus less constrained in that it can embed simultaneous infinitives even when the attitude holder is certain of the truth (38b) or falsity (39) of the complement.

(39) Mikhail wanted to be sitting on a beach somewhere, but he was stuck in the office.

We have seen here that *hope*, *expect*, and *want* permit the embedding of FUT, but do not necessitate it. In the next section, we will see that there are a class of predicates which *must* embed FUT and that this correlates with other behavior particular to this class of verbs.

6. Obligatorily future oriented predicates

Given that *forecast* is not an obligatorily future oriented predicate in English (fn.2), it appears that the generalisation tying together this class is that they involve commitment to act (whether private or public). They are all verbs of intention (list adapted from Grano (2017b)).

(40) a. Verbs of private commitment: *aim, choose, decide, endeavour, intend, plan*
b. Verbs of public commitment: *agree, offer, pledge, promise, swear, threaten*
c. Verbs of influence: *advise, ask, command, order, persuade, convince, urge*

Grano (2017b) suggests that the verbs in (40) all encode the RESP relation of Farkas (1988) as part of their semantics. Intentional verbs are all infelicitous with complements that describe states of affairs which are not under the control of the understood subject of the embedded infinitive.

(41) a. #Mihail {promised/asked/decided} to be tall.
b. #Mikhail {promised/asked/decided} to resemble his father.

Compare this to the other verbs we have considered above.

(42) a. Mihail {hoped/wanted/expected} to be tall.
b. Mikhail {hoped/wanted/expected} to resemble his father.

(43) a. Mikhail {claimed/pretended/believed Judit} to be tall.
b. Mikhail {claimed/pretended/believed Judit} to resemble his father.

In the literature it is often noted that states of affairs at a time prior to, or equal to, NOW are *presupposed to be settled* (Condoravdi, 2002; Kaufmann, 2005; Kaufmann et al., 2006) in the sense that they can no longer be influenced (intentionally or otherwise). We propose that it is systematically infelicitous for an individual to be in the RESP relation to φ whenever the truth or falsity of φ is presupposed to be metaphysically settled. Let us propose, therefore, that the RESP relation has a *metaphysical unsettledness* requirement. The truth or falsity of φ must not be metaphysically settled at the time of the intention. The only propositions which are not metaphysically settled are those that involve a future operator.

7. Potential counter examples

There are three potential counterexamples to the above generalisations that we are aware of: *try*, *suspect*, and *be certain*. Fristly, Grano (2017b) classes the verb *try* with verbs of intention. If so, it should be obligatorily future oriented (counter to fact).

(44) Judit tried to win (*tomorrow).

However, it is potentially incorrect of Grano to class *try* with the other verbs of intention. It is possible that although *try* involves intention in the intuitive sense, it is less clear that it involves the RESP relation as it can embed some predicates which cannot be embedded under other verbs of intention. For instance, Jackendoff and Culicover (2003) note that the predicate *understand physics* cannot be embedded under verbs of intention. However, it can readily be embedded under *try*.[12]

(45) a. #Mikhail {promised/asked/decided} to understand physics.
b. Mikhail tried to understand physics.

More problematic is the verb *suspect*. If we were to give *suspect* a similar semantics to that of *expect* then we should predict that it can embed FUT (counter to fact).

(46) a. *Judit suspects Mikhail to win tomorrow.
b. Judit suspects Mikhail to be the murderer.

It is possible, then, that diversity is a necessary but not sufficient condition for licensing FUT. Nonetheless, further research is certainly required here.[13]

Lastly, it intuitively appears that we predict that the raising predicate *be certain* should be obligatorily simultaneous. Rather, it behaves like its weaker, optionally future oriented counterpart *be likely* in also allowing future orientation.

(47) Judit is {likely/certain} to win tomorrow.

It is possible, however, that *be certain* does not have a quantificational structure comparable to *believe* or modals like epistemic *must*. Rather, it is a probability operator which maps its prejacent to the maximal degree on a probability scale (e.g., [0,1]). Portner (2009: pp.73-9) notes that, while we need a compositional account of such operators, they are fundamentally different from run-of-the-mill modals. Of course, whether these facts are consistent with the

[12] For more on *try* see Sharvit (2003); Grano (2011, 2017a).

[13] Angelika Kratzer and Daniel Rothschild (pc) point out that *suspect*'s apparent weakness (e.g., compared to *believe*) is not necessarily indicative of an ordering semantics, but rather could be attributable to the modal base simply being a subset of the doxastic alternatives (similar to how, in the general case, doxastic alternatives are a subset of epistemic alternatives). If this were so, then *suspect* would not be a counter example to the present proposal. However, it remains to be seen whether or not this move would be justified.

current proposal ultimately depends on what turns out to be the most appropriate way to model probability operators.

So far, we have shown how the proposed semantics for FUT derives the distribution of the contingent future in infinitival complements to attitude predicates. However, since our semantics for attitude predicates shares its quantificational structure with modal auxiliaries, we would ideally derive the distribution of FUT under modal auxiliaries too. In the next section, we will show how this proposal extends straightforwardly to epistemic modals and directive uses of deontic modals.

8. Modal auxiliaries

8.1. Epistemic modals

8.1.1. The generalisation

Epistemic modals have the following temporal properties: 'strong' necessity modals cannot be future oriented, while 'weak' necessity modals and possibility modals can. Firstly, consider the the following epistemic possibility modals, which all permit a reading in which the prejacent holds of a future time.

(48) Judit {might/may/could} be sick tomorrow.

Even in the absence of temporal adverbials, a future reading is forced if the prejacent receives an episodic reading of an eventive predicate.

(49) Judit {might/may/could} win.

This is likely due to the constraint against the simple present with eventive predicates in English and many other languages (Giorgi and Pianesi, 1997). Since a simultaneous reading is ruled out, the future oriented reading is forced.

Next consider epistemic strong necessity modals. These permit an epistemic reading when interpreted simultaneously.

(50) Judit {must/has to/can't} be at home (already).

However, when the prejacent is modified by a future adverbial like *tomorrow* an epistemic reading is impossible (Enç, 1986; Stowell, 2004; Lekakou and Nilsen, 2008; Portner, 2009).

(51) *Judit {must/has to/can't} be sick tomorrow. (*epistemic*)

Likewise, they cannot receive an epistemic reading when their prejacent is a episodic eventive predicate.

(52) *Judit {must/has to/can't} win. (*epistemic*)

Finally, consider epistemic weak necessity modals. While these are harder to construe with an epistemic reading, they nonetheless pattern with possibility modals rather than strong necessity modals (see especially Banerjee, 2018a: who independently proposes a similar account to the one developed here).

(53) Judit {should/ought to} be sick tomorrow. (*epistemic*)

(54) Judit {should/ought to} win. (*epistemic*)

In sum, epistemic possibility modals and weak necessity modals permit future orientation. Epistemic strong necessity modals do not.

8.1.2. The account

Epistemic modals have been proposed to have a special architecture. Yalcin (2007) and Anand and Hacquard (2013) propose that epistemic modals quantify directly over worlds in the modal context. In matrix declaratives, the modal context is the epistemic alternatives of the speaker in the evaluation world, at the evaluation time. Based on these assumptions, we predict that FUT should not be embedded under an epistemic which encodes that its modal base is uniform with respect to its prejacent. This is precisely what epistemic strong necessity modals have been proposed to encode. von Fintel and Gillies (2010) argue that strong necessity modals do not have a ordering source, and thus do not have a diversity requirement.[14]

(55) $[\![\text{must } \varphi]\!]^{w,t,S} = 1 \text{ iff } \forall \langle w', t' \rangle \in S : [\![\varphi]\!]^{w',t',S} = 1$

If we were to assume a diversity condition on epistemic strong necessity modals (Werner, 2006; Giannakidou and Mari, 2018: *inter alia*) then we would be without an account as to why they cannot embed contingent future prejacents. To account for the future orientation of weak necessity modals, on the other hand, we appeal to the idea that weak necessity encodes the promotion of an ordering source (von Fintel and Iatridou, 2008; Rubinstein, 2012). A modal like epistemic *should* would quantify over only the most likely of the worlds in S. Epistemic possibility modals existentially quantify over S, and can consequently satisfy the contingency presupposition of the FUT. On this picture, what distinguishes epistemic strong necessity modals from weak necessity modals and possibility modals is that only in the case of strong necessity modals is the modal base required to be uniform with respect to the prejacent. FUT is therefore ruled out under epistemic *must* for much the same reason as it cannot be embedded directly under *believe*.

Kaufmann (2005) suggests that matrix assertions involve a covert necessity modal $\emptyset$. He further shows that *woll*, realised as present tense *will* and past tense *would*, is weaker than $\emptyset$ and thus requires an ordering source. Unfortunately, space limitations preclude a more complete discussion of *woll* here. However, Kaufmann's suggestion that *woll* is weaker than $\emptyset$ should be sufficient for it to license FUT.[15,16]

[14] According to von Fintel and Gillies (2010) the apparent weakness of *must* when compared to a bare assertion is due to a presupposition that φ is established indirectly (see also Mandelkern, 2016). On the other hand, Lassiter (2014) and Goodhue (2017) provide alleged arguments against a strong semantics for *must*. Angelika Kratzer (pc) observes that apparent normalcy conditions which restrict the domain of *must* are always defeasible and as such we should refrain from building them into the semantics. Nonetheless, whether the semantics of *must* involves domain restriction is still a topic of serious debate (e.g., von Fintel and Gillies, 2018).

[15] For evidence that *woll* is a genuine modal and not simply a future marker see Klecha (2014).

[16] It is worth noting that *woll* does not obligatorily embed FUT. There are instances where *will* can be used with a present reference time (Kaufmann, 2005; Giannakidou and Mari, 2018).

(i) a. Mikhail will be in his office already.
 b. [Upon hearing the doorbell] That will be Judit now.

Before moving on, it is worth considering how a modal like *might* licenses FUT in embedded finite clauses.

(56) $[\![\alpha \text{ believes that it might FUT rain}]\!]^{w,t,S} =$
a. defined iff $\exists\langle w',t'\rangle \in \text{Dox}_{w,t,\alpha} : \exists t'' > t' : [\![\text{rain}]\!]^{w',t'',\text{Dox}_{w,t,\alpha}} = 1 \wedge$
$\exists\langle w',t'\rangle \in \text{Dox}_{w,t,\alpha} : \neg\exists t'' > t' : [\![\text{rain}]\!]^{w',t'',\text{Dox}_{w,t,\alpha}} = 1$
b. if defined, $= 1$ iff $\forall\langle w',t'\rangle \in \text{Dox}_{w,t,\alpha}$:
$\exists\langle w'',t''\rangle \in \text{Dox}_{w,t,\alpha} : \exists t''' > t'' : [\![\text{rain}]\!]^{w'',t''',\text{Dox}_{w,t,\alpha}} = 1$

Here the universal quantification of *believe* in the first line of (56b) is vacuous, and FUT(rain) need not be true throughout the modal base. This is in contrast to non-finite complements where no modal auxiliary is present to license FUT.

8.1.3. A note on Klecha (2016)

Recent work by Klecha (2016) proposes that epistemics never permit a future oriented reading, and the instances of future readings for *might* is due to it being interpreted metaphysically (Condoravdi, 2002: *inter alia*). Moreover, Klecha maintains that *hope* and *expect* do not have a doxastic modal base when future oriented. Again, he suggests that in such instances they have a metaphysical modal base.

Klecha's proposal differs from the present account, and it is worth considering whether there is any reason to prefer one over the other. Firstly, concerning attitude predicates, Banerjee (2018b) shows convincingly that the modal base of *hope* cannot be metaphysical when future oriented, as this makes incorrect predictions. Secondly, there is good reason to think that modals like *might* can be truly epistemic even when future oriented. This is because the metaphysical reading of epistemics can take narrow scope with respect to other operators (such as the past marker *have*), while true epistemics are notorious for taking wide scope, so-called *epistemic containment* (von Fintel and Iatridou, 2003). The canonical contrast is given in (57). Example (57a) conveys epistemic possibility about a past event, while (57b) conveys a metaphysical possibility from some past time (Condoravdi, 2002).

(57) a. Mikhail might already have won the race. ($\exists >$ *have*, **have* $> \exists$)
b. At that time, Mikhail might still have won the race. (*have* $> \exists$)

Crucially, quantificational subjects cannot scope over the modal when it is construed epistemically. Given that a race can only have one winner, it is infelicitous to assert that it is possible that every runner won (58a). However, when the modal is construed metaphysically, the universal can take wide scope (58b) and the claim is that every runner is such that, at that time, they might go on to win the race.

(58) a. #Every runner might already have won the race. (#$\exists > \forall$, *$\forall > \exists$)
b. At that time, every runner might still have won the race. ($\forall > \exists$)

Now note that, on its future oriented reading, *might* nonetheless appears to exhibit epistemic containment. The universal in (59) only very marginally scopes over the epistemic with awkward stress. In fact, many speakers judge (59) infelicitous altogether, suggesting that they are not accessing a metaphysical reading at all. However, if future oriented *might* is always metaphysical, we should expect (59) to be completely sensible on the reading intended. The fact that it is not suggests that the default reading for future oriented *might* is nonetheless epistemic.

(59) #Every runner might win the race tomorrow. (#$\exists > \forall$, *$\forall > \exists$)

8.2. Directive uses of deontic modals

Deontic *may* and *must* cannot be used to place someone under an obligation or grant someone permission to bring about a state of affairs which cannot be done so intentionally.

(60) a. #You must {be tall/resemble your father}! (*deontic*)
b. #You may {be tall/resemble your father}. (*deontic*)

Similarly, their prejacent cannot be about a past time (Ninan, 2005).

(61) a. #You must have tidied your room yesterday! (*denotic*)
b. #You may have eaten a cookie earlier. (*deontic*)

Above, we proposed to capture similar data by proposing that the RESP relation bears certain constraints. The data in (60) and (61) would suggest that the same constraints are at play with directive uses of deontic modals. Whatever the status of the RESP relation, it is nonetheless clear that directive uses of *may* and *must* pattern like obligatorily future oriented predicates both with respect to what sort of prejacent they can have, as well as their temporal orientation.

9. Conclusion

This paper has proposed a compositional semantics for the (contingent) future which places a constraint on the environments in which it can be embedded. We focused specifically on deriving the distribution of future orientation in infinitives in English. Beyond English, however, Laca (2015) has shown that similar constraints are at play in Spanish subjunctive complement clauses. We further showed how our semantics made correct predictions for epistemic modals and directive uses of deontic modals. The account proposed has a similar motivation to that of Klecha (2016) in that it aims to give a unified account for the temporal orientation of modal prejacents and attitude complements. However, it differs from Klecha's account in that it takes the determining factor to be, not modal flavor *per se*, but rather modal diversity. In that respect, it has much in common with Banerjee (2018a, b), who has independently arrived at a similar conclusion. Crucially, this account rests on the assumption that not all modal bases have a diversity requirement. This last point is a contentious issue, and one which is still under debate. If the above proposal is correct, then it may support the notion that diversity is not a prerequisite for every modal base.

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Even though as *even if*[1]

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Abstract. In this paper, I propose a new semantics for *although/even though*. My proposal makes use of the scalar likelihood presupposition of *even*, and I argue that the concessivity of *although* comes from scalar likelihood comparison of two conditional propositions. I present both formal and empirical advantages of such an account.

Keywords: scalar presupposition, concessivity, although.

1. Introduction

English has a wide variety of constructions used to convey the oddity of two propositions put together, often called "contrastive" or "concessive". Various particles have been claimed to be a part of this class, including *(al)though*, *even though*, and *still*, *nevertheless*, *but*, *despite*, among many others. The descriptive literature on concessive constructions characterize them as "the unexpected, surprising nature of what is being said in view of what was said before that" (Quirk et al., 1972).

These constructions convey the truth of both propositions as well as the fact that the combination of the two propositions is odd or unexpected. Although they are often studied together, I examine just the particles *even though* and *although*, which are nearly identical in use and which I shall generally treat as interchangeable.

(1) John went out for a walk, even though it's raining. $\quad$ q, even though p

(2) Although Bailey is rich, she doesn't give to charity. $\quad$ although p, q

2. What is asserted by *although*?

Concessive constructions are often grouped together and labeled "conjunctions" based on the fact that they convey two propositions; many accounts of *although* assume that it, like other similar constructions, assert the two propositions involved (e.g. Pasch 1992, Lund 2017). However, a closer examination reveals particles differ on that regard: some of these particles (i.e. *but*) truly assert a conjunction, whereas *although* does not.

Let us compare near-synonymous constructions of the form "although p, q" and "p but q".[2] We can demonstrate using attitude predicates that the *although*-constructions only convey that the attitude is held of q, and the *but*-constructions convey that the attitude is held of both p and q.

(3) a. Mary is happy that although John didn't study for the test, he passed it.
$\not\Rightarrow$ Mary is happy that John didn't study, $\Rightarrow$ Mary is happy that John passed the test

b. Mary is happy that John didn't study for the test but (still) passed it.
$\Rightarrow$ Mary is happy that John didn't study, $\Rightarrow$ Mary is happy that John passed the test

[1] I'd like to thank Roger Schwarzschild, Justin Khoo, Gunnar Lund, Vann McGee, Kai von Fintel, and other audience members and reviewers for helpful commentary.

[2] I use p to refer to both the clause headed by *although* and the clause **not** headed by *but*.

Additionally, we can observe that an *although*-construction projects *p* when embedded under a non-factive predicate, whereas a *but*-construction does not. This suggests that *p* in *although*-constructions is part of the not-at-issue content.

(4) a. Mary wonders if, although John studied for the test all night, he failed it.
$\Rightarrow$ John studied all night, $\not\Rightarrow$ John failed the test
b. Mary wonders if John studied for the test all night but failed it.
$\not\Rightarrow$ John studied all night, $\not\Rightarrow$ John failed the test

Additionally, we can show that the content of *p* within an *although*-construction, which is not-at-issue, is not felicitous as an answer to a question. This is in contrast with the same *p* within a *but*-construction.

(5) A: Are you a pianist?
a. B: ?? Although I do play piano, I'm not a professional.
b. B: I do play piano, but I'm not a professional.

The same answer (5b) is felicitous when *q* is the question answer, showing that *q* is part of the at-issue content.

(6) A: Are you a professional pianist?
B: Although I do play piano, I'm not a professional.

The question of whether *p* is a presupposition or a conventional implicature à la Potts (2005) is harder to diagnose. The latter option may initially seem promising, as *although*-constructions are often used to introduce *p* as new content, such as in (6). However, at least one test, the presuppositional plug test, favors the status of *p* as a presupposition rather than a conventional implicature like *as*-parentheticals.

With the presuppositional plug test, we can observe that the factive presupposition of *realize* can be blocked by a predicate of speech (7). On the other hand, a conventional implicature cannot be cancelled under such predicates (8). In (9), we observe that *p* under an embedded *although*-construction can be cancelled. This example suggests that *although* is less speaker-oriented than appositives, as the content of *p* can be more easily attributed to the subject of a speech report rather than the speaker.

(7) John said that Sue realized Kaitlin lives in poverty. (Later we found out that John was wrong. Sue can't have realized that Kaitlin lives in poverty, because Kaitlin is well off.)
(adapted from Potts 2005)

(8) Joe said that Kaitlin, a friend of his living in poverty, is quite happy. # But in fact, Kaitlin doesn't live in poverty.

(9) Joe said that although his friend Kaitlin lives in poverty, she's quite happy. ✓ But in fact, Kaitlin doesn't live in poverty.

I'll treat the content of *p* as a presupposition (following the intuition of König and Siemund 2000), leaving open the question of whether a conventional implicature approach would be preferable.

3. The oddness/concessive inference

3.1. The conditional approach

Previous works on *although* focus on capturing the oddness presupposition that it contributes, the most influential account being that of König and Siemund (2000). Their proposal approaches the oddness inference by positing a conditional as the presupposition.

One tangential motivation for approaching *although*-constructions using conditionals is an observation (at least since Kortmann 1996) that concessive constructions have a close connection with concessive *even if* conditionals, by which the following pair is near-synonymous:

(10) Even if your friend dislikes museums – which I know he does – he'd enjoy a visit to the MOMA. (adapted from K&S 2000)

(11) Even though your friend dislikes museums, he'd enjoy a visit to the MOMA.

König and Siemund note two such links. Diachronically, concessive conditionals often develop into *though*: English *though* was also formerly a conditional marker. Second, many languages use the same construction for *even though* and *even if* (e.g., French *même si* and Italian *anche se*).

Another motivation for this approach is through the lens of comparison with *because* clauses, which is the subject of much discussion (König 1989, Iten 1997, a.o.). In *because*-constructions, p is the cause of q, whereas in concessive constructions, p normally causes $\neg q$.

(12) Because it was raining, John didn't go out for a walk.

(13) Although it was raining, John went out for a walk.

The intuition behind their approach is that the rainy weather normally results in John not going out for a walk. In (12), one can roughly posit a conditional as the sentence presupposition that expresses $p \rightarrow q$, whereas in (12) such a conditional would be $p \rightarrow \neg q$. In fact, almost all previous accounts of concessive constructions rely on such a conditional (Winter and Rimon 1994, Iten 2000, König 1989, König and Siemund 2000, inter alia).

The challenge of these accounts is in how to transform $p \rightarrow \neg q$ into an acceptable presupposition of *although*, as presupposing exactly $p \rightarrow \neg q$ would contradict the fact that concessive constructions convey $p \wedge q$. The tension between $p \rightarrow \neg q$ and $p \wedge q$ must be represented: the meaning that is conveyed is that the normal or expected course of events did not occur. König and Siemund suggest that the oddness presupposition of *although*-constructions should be schematized as $P \rightarrow \neg Q$, in which P and Q are propositions involving "quantification and generalization" of p and q respectively. For example, if p is "it's raining" and q is "John went out for a walk", $P \rightarrow \neg Q$ would be paraphrased as "if it's raining, John normally does not go for a walk".

3.2. The scalar conjunctive approach

Objecting to the non-compositional nature of König and Siemund (2000), Lund (2017) offers a compositional account making use of the independent meaning of *even* in *even though*. Using the scalar likelihood presupposition of *even*, Lund makes two crucial assumptions to derive $(p \wedge q) <_{likely} (\neg p \wedge q)$ as the presupposition of "although p, q". First, he assumes that the assertive form of *although*-constructions is a conjunction, which I have argued against above. Second, he requires a verum operator over p to generate the alternative set $\{p, \neg p\}$ in order to generate the negation for *even* to compute over, perhaps an improvement over the unmotivated negation over the q proposition in the traditional account. Skipping the details of the composition, I present an informal schematic of the account.

(14) even though p, q
   a. assertion: $p \wedge q$
   b. scalar presupposition: $\forall r \in \{p \wedge q, \neg p \wedge q\}[[r \neq (p \wedge q)] \supset [(p \wedge q) <_{likely} r]]$
      equivalent to: $(p \wedge q) <_{likely} (\neg p \wedge q)$

(15) Even though it's raining, John went out for a walk.
   a. assertion: It's raining $\wedge$ John went out for a walk.
   b. scalar presupposition: [That it's raining $\wedge$ John went out for a walk] is less likely than [that it's not raining $\wedge$ John went out for a walk].

3.3. Empirical challenges of these accounts

I present further empirical data to evaluate these two approaches, showing that both are problematic.

3.3.1. The problem with scalar conjunctions

Lund's (henceforth: scalar conjunctive) presupposition is fundamentally quite different from the traditional presupposition: "normally, $p \rightarrow \neg q$". Our task is to devise a context in which the scalar conjunctive presupposition is met, but not the traditional one.

Let us consider (16), relying on the following world knowledge: Europeans who speak both Catalan and Spanish ($c \wedge s$) are less common than those who speak Spanish and not Catalan ($\neg c \wedge s$); thus the conjunctive presupposition is met. However, Europeans who speak Catalan largely also speak Spanish, contradicting the traditional presupposition.[3]

(16) *Eva is European.* #Although she speaks Catalan, she also speaks Spanish.
although c, s
scalar conjunctive presupposition: Eva speaks Catalan and Spanish $<_{likely}$ Eva doesn't speak Catalan and speaks Spanish $(c \wedge s) <_{likely} (\neg c \wedge s)$

The scalar conjunctive presupposition incorrectly predicts (16) to be felicitous. The scalar presupposition is met: that Eva speaks both Catalan and Spanish ($c \wedge s$) is less likely than

[3]Compare (16) with the following felicitous example, which relies on the world knowledge that religious practice is often mutually exclusive:

(1) Although Eva practices Judaism, she also practices Buddhism.

that Eva speaks Spanish and not Catalan ($\neg c \wedge s$). On the other hand, the traditional account correctly predicts infelicity with a presupposition that is not met: it is not normally the case that speakers of Catalan don't speak Spanish; in other words, Catalan speakers normally speak Spanish.

I take these data as evidence against a scalar conjunctive presupposition. Although the traditional presupposition is plausible for this example, we'll see examples in which it is inadequate. Instead, I propose an account which retains the insight of using the presupposition of *even*, and that makes a stronger theoretical link between concessive "conjunctions" and concessive conditionals. Recall the arguments against *although* constructions asserting a conjunction. Let us make a simple modification of the scalar presupposition: we change the scalar presupposition to operate over an alternative set of conditionals, instead of conjunctions:

(17) revised scalar presupposition: $(p \rightarrow q) <_{likely} (\neg p \rightarrow q)$

Such a revision involves comparative likelihood of conditionals. The topic of the propositional status and likelihood comparability of conditionals deserves lengthy discussion such as in the philosophical literature (e.g. Rothschild 2013), but for our purposes here, we may assume that a conditional is more likely than another if the attitude holder judges that there is stronger evidence to support it.

We can check that such a presupposition correctly predicts infelicity when applied to (16). It results in the following presupposition: [that Eva speaks Spanish if she speaks Catalan] is less likely than [that Eva speaks Spanish if she doesn't speak Catalan]. This goes against our world knowledge, in which (speaking Catalan $\rightarrow$ speaking Spanish) is more likely than (not speaking Catalan $\rightarrow$ speaking Spanish).

3.3.2. Against the traditional account

So far, we have not presented empirical evidence against the traditional presupposition, as Lund (2017) only offers theoretical reasons to disfavor it. Below, I present two classes of counterexamples to the traditional presupposition.

First of all, examples in which q is true independently of a possibly relevant p or $\neg p$ are in principle compatible with the traditional account. In (18), any account based on generalizing $p \rightarrow \neg q$ would be able to generate a true presupposition: if it isn't raining on a given day, Mary normally uses the treadmill.[4] Such a mechanism makes it difficult to account for the infelicity of (18).

(18) *The weather doesn't affect Mary's exercise routine; Mary uses the treadmill almost every day.*
Although it didn't rain today, Mary didn't use the treadmill.

[4]One might object to using as a presupposition a non-concessive conditional in which the consequent is entailed. But such conditionals are in fact assertable to convey indifference to the antecedent: "if it rains, I go jogging and if it doesn't rain, I go jogging".

A scalar likelihood account has no problem predicting infelicity. The conditional statements $p \rightarrow q$ and $\neg p \rightarrow q$ are equally likely, as whether it rains does not affect Mary's use of the treadmill. Thus, the scalar presupposition, which requires one conditional to more more likely than another, is not met.

A second challenge to the traditional presupposition comes in the form of examples in which the presupposition does not hold, yet the sentence is felicitous.

(19) Although the underdog contestant made the finals, she didn't win the contest.

In (19), world knowledge tells us that multiple contestants will make the finals. Thus, it's not the case that a contestant who reaches the finals normally wins. One might propose that the traditional account could fix such examples by restricting the conditional presupposition to make use of bouletic modality, resulting in a presupposition paraphrased as "if the contestant makes the finals, in all her most desired worlds, she wins the contest". However, such a move would further weaken the already flexible nature of the "normally" generalization mechanism.

Using a scalar presupposition, accounting for felicity is simple: for a contestant not to win if she didn't make the finals is trivially true, and is thus more likely than for her not to win if she did make the finals.

A third challenge to the traditional account comes from example in which p entails q, and thus $p \rightarrow \neg q$ would be a logical contradiction.[5] In (20), it's false that if one is from New Caledonia, one is normally not from France.

(20) Although Luc is from New Caledonia, he's still from France.

In (20), the scalar likelihood presupposition is met, assuming a modification to our account below, and the focus alternative set {New Caledonia, mainland France}. The presupposition would be the following: for Luc to be from France if he's from mainland is more likely than for him to be from France if he's from New Caledonia. This presupposition is met if we make the reasonable assumption that the modal base of likelihood to contain more worlds in which New Caledonia is not a part of France. Under the traditional account, (20) would falsely presuppose that normally, if Luc (or someone else) is from New Caledonia, he isn't from France.

4. Proposal

Let's begin to formalize the scalar account proposed in this paper using (23), with a standard semantics for *even* and without committing to the semantics of the conditional. The only difference between *if* and *though*-conditionals is that *though*-conditionals presuppose that the antecedent is true. This presupposition, together with the conditional assertion, entail the truth of q. Thus, *though* is a special form of the conditional which is felicitous and true only in worlds in which both the antecedent and consequent are true.

(21) Even though it's raining, John went out for a walk.

(22) $\text{though}^{c,g} = \lambda P_{st} \lambda Q_{st} \lambda w : P(w) = 1$. it is true of w that if P, Q

[5] Examples of this form are discussed for *although* in Iten (2000), in response to examples with *but* in Winter and Rimon (1994).

(23) $\text{even}^{c,g} = \lambda C_t \lambda R_{st} \lambda w : \forall S_{st} \in C[[S \neq R] \supset R <_{\text{likely}} S].R(w) = 1$

(24) [even C_1][though[p][q] $]^{c,g} = \lambda w : p(w) = 1 \wedge \forall S_{st} \in C_1[[S \neq \text{if } p, q] \supset \text{if } p, q <_{\text{likely}} S]$. if p, q is true of w

Let's specify C_1 as the focus semantic value of the expression above, and continue the derivation.

(25) $C_1 :=$ though[it's raining][John went out for a walk]^F = {*if it's raining then John went out for a walk*, *if it's not raining then John went out for a walk*}

(26) [even C_1][though[it's raining][John went out for a walk] $]^{c,g} = \lambda w$: it's raining in w $\wedge$
[if it's raining then John went out for a walk] $<_{likely}$ [if it's not raining then John went out for a walk].
it is true of w that if it's raining, John went out for a walk

The final step is then to saturate (26) with a world variable w_c.

The presupposition that we generated relies on the likelihood comparison of two conditionals, mirroring Guerzoni and Lim's (2007) account of *even if* conditionals. This formalism requires the speaker to reason that each world in the epistemic modal base is such that one conditional, the antecedent of which is entailed by the epistemic modal base, is less likely than another conditional in which the antecedent is false in the epistemic modal base. This does not pose a problem, as the mechanics of the conditional will allow for access to worlds outside the epistemic modal base, just like the mechanism for counterfactual conditionals. The oddness inference can be paraphrased as follows: given that p is true, and that q is more likely to follow from $\neg p$ than p, our assertion is that $p \rightarrow q$ and thus q are true.

So far, we have motivated a crucial modification of Lund's account, in which an *although*-construction necessarily generates the alternative set $\{p \rightarrow q, \neg p \rightarrow q\}$.

4.1. Apparent challenges to the proposal

One prediction of the scalar likelihood account is that any p, q such that $\neg p$ entails q should be felicitous, as the more likely proposition $\neg p \rightarrow q$ would be trivially satisfied. To demonstrate, we can set p as my being from Texas and q as my not being from El Paso. My account would thus generate the presupposition that it's more likely that for me to not be from El Paso if I'm not from Texas than for me not to be from El Paso if I am from Texas; the more likely proposition is trivially true.

(27) ?? Although I'm from Texas, I'm not from El Paso.

(28) *compare with:* Although I'm from the UK, I'm not from England.

Although we have seen a clear example of this type that's felicitous (19),[6] such examples are not felicitous across the board. Such a view would be expected from the traditional approach,

[6](19)'s scalar presupposition, that if one didn't make the finals one didn't make the contest, is a necessary truth under normal laws.

as the traditional presupposition, that if someone is from Texas then that person is normally from El Paso, is not met. However, although (27) may seem degraded when imagined in an out-of-the-blue context, it becomes perfectly felicitous when the information that the sentence contributes is relevant, such as in a context in which q is the answer to a question.

(29) *Let me guess which US city you're from. Are you from El Paso?*
Although I am$_F$ from Texas, I'm not from El Paso.

Thus, my prediction is borne out: any two propositions p and q such that $\neg q$ entails p should be felicitous in *although*-constructions.

A second challenge to my account comes from examples in which it appears that q entails p.[7]

(30) Although I speak French, I speak French poorly.

This example may seem to favor a traditional presupposition, as it is true that one who speaks French normally speaks it better than poorly. Under a scalar approach, the alternative presupposition generated by a verum operator on the antecedent would be that if I don't speak French I speak it poorly, which is contradictory and cannot be more likely than the prejacent conditional.

However, when we look at such examples more broadly, we see that consequents of this form without some sort of negation or exclusivity are degraded.[8]

(31) a. ?? Although Luc is from France, he's from New Caledonia / an overseas department.
b. Although Luc is from France, he's not from mainland France.

(32) a. ?? Although I play the piano, I'm a beginner.
b. Although I play the piano, I'm only a beginner.

A traditional account won't be able to distinguish between the members of the pairs, as "if Luc/someone is from France, he's normally not from an overseas department" is (roughly) truth-conditionally equivalent to "if Luc/someone is from France, he is normally from mainland France". On the scalar account, the assertions in the consequents themselves of the felicitous (b) examples don't entail the antecedent, thus removing the initial challenge. I rely on an analysis of *only* in which the assertion of "I'm only a beginner pianist" is paraphrased as "I'm a beginner pianist or not a pianist"; the assertion of the sentence must rely on an existential presupposition "I'm a pianist at some level" to entail the prejacent "I'm a beginner pianist". Thus, the more likely conditional in the presupposition is that if I don't play the piano, I'm not a pianist (or a beginner pianist). This is trivially true, and thus more likely than if I play the piano, I'm a beginner pianist (or not a pianist). Going back to the speaking French example,

[7] Note that this is exactly the reverse of examples such as (20).

[8] In comparison with (20), both pairs are similar in acceptability, as predicted by the scalar account and contra the traditional account:

(21) Although Luc is from New Caledonia, he's (still) from France.

(21′) Although Luc is not from mainland France, he's (still) from France.

we can assume a covert exhaustivity operator that renders “I speak French (only) poorly$_F$” to mean I speak French poorly or not at all.

5. The additive presupposition and concessive still

The move from conjunctive to conditional presuppositions allows us room for test the presence of the additive presupposition. Under a scalar conjunctive account, the additive presupposition would be $\neg p \wedge q$, and was excluded from the meaning of *even* scoping over such examples, as it contradicts the assertion $p \wedge q$. However, the additive conditional presupposition, $\neg p \rightarrow q$, does not contradict the assertion $p \rightarrow q$.

There is evidence that the additive conditional presupposition is not part of the meaning of some concessive constructions, which we can test using a provided context as well as the availability of the additive particle *still*.

(33) a. *It's a weekday morning.*
Although Ana had a sore throat, she (✓still) went to work.

b. *Ana woke up to a sore throat. She grabbed the wrong bottle of pills from her medicine cabinet.*
Although Ana had a sore throat, she (#still) took the headache medicine.

(34) a. *The school canteen is undergoing repair and the only other available eating space is the yard.*
Although it was raining outside, the schoolchildren (✓still) had to eat lunch in the yard.

b. *The teacher decided to punish to the students today; the schoolchildren normally eat in the canteen.*
Although it's raining outside, the schoolchildren (#still) had to eat lunch in the yard.

Our new paradigm in which the presupposed content is conditional in form allows us a simple way to capture the distinction between (a) and (b) examples: (a) examples satisfy the additive presupposition and are licit with *still*, whereas (b) examples do not, and are illicit with *still*. Thus, *still* is the operator that contributes the additive presupposition in concessive constructions.

(35) additive presupposition of [even [though p, still q]]: $\exists r \in \{p \rightarrow q, \neg p \rightarrow q\}[[r \neq (p \rightarrow q)] \wedge [r(w) = 1]]$
equivalent to: $(\neg p \rightarrow q) = 1$

(36) Although Ana had a sore throat, she still went to work.

a. additive presupposition: if Ana didn't have a sore throat, she would go to work.

6. Conclusion

I have proposed a semantics for concessive constructions that relies on conditionals as part of their presupposed content. I proposed that *although*-constructions assert a conditional and have as the basis for their concessive meaning a scalar presupposition comparing two conditional propositions, modifying the view in Lund (2017) in which these constructions are fundamentally conjunctions in meaning. The account proposed here allows room for concessive *still* to contribute an interpretive difference in *although*-constructions in the form of an additive conditional presupposition, paving the way for more refined predictions.

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Accounting for the "causal link" between free adjuncts and their host clauses[1]

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Abstract. This paper investigates the causal interpretation of *free adjuncts*. These are non-clausal adjuncts that associate with an individual denoted by an argument of the main verb and contribute propositional content about that individual (e.g., *being an Englishman* in *John, being an Englishman, is brave*). Based on a comparison with *since*-clauses, I analyze causally interpreted free adjuncts as contributing presuppositional propositional content that provides supporting evidence for the speaker's main claim. I argue that the "causal link" responsible for this interpretation is not contributed by the free adjunct but inferred. I propose that it is pragmatically necessary that the presuppositional content of the free adjunct is linked to the truth-conditional content of the host clause and that the causal flavor follows from general pragmatic requirements placed on the assertion act.

Keywords: free adjuncts, causal interpretation, presupposition, assertion.

1. Introduction

Free adjuncts are non-clausal adjuncts (**boldface** in (1)) that associate with an individual denoted by an argument of the main verb (underlined in (1)) and contribute propositional content about that individual (see Fabricius-Hansen and Haug, 2012; Stump, 1985). The main semantic puzzle posed by free adjuncts is how the propositions that they contribute relate to the matrix propositions of their host clauses. Example (1) illustrates a subset of all possible links; for each sentence, the preferred link is made explicit with the semantically closest adverbial clause.

(1) a. John, **being an Englishman**, is brave.
(≈ Since John is an Englishman, he is brave.) (causal)
b. **As a child**, Jerrie had red hair.
(≈ When Jerrie was a child, she had red hair.) (temporal)
c. **Wearing this**, Peter would appeal to Mary.
(≈ If Peter were wearing this, he would appeal to Mary.) (conditional)

The full range of possible links found for free adjuncts has been addressed by a number of authors (see the discussion in Stump, 1985: Ch. 1). Curme (1931: 154–157) provides the most extensive list. He finds that free adjuncts may perform the same functions as causal, temporal, conditional, and concessive adverbial clauses. In addition, they can be used to describe *attendant circumstances*[2] or the manner in which the main clause eventuality is performed.

Stump (1985) presents a first semantic analysis of these expressions that is restricted to those free adjuncts that perform adverbial-clause-like functions. One of Stump's central observations for this subset is that the causal-clause-like and concessive-clause-like interpretations are possible for all adjuncts, while the temporal and conditional interpretations are only available for what he calls "weak free adjuncts" (e.g., *as a child* in (1b) and *wearing this* in (1c)). Over-

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[2]*Attendant circumstances* are circumstances that are co-temporal to those described by the main clause but do not have any other connection to them; cf. depictive secondary predicates, Rothstein (2006).

all, the causal-clause-like interpretation has a special status among the possible interpretations: in addition to being available for all adjuncts, it is also potentially available in any context. Hence, sentences like (1b) and (1c) are potentially ambiguous. For instance, (1b) can also be understood as stating "since Mary is a child, she had red hair at some point in the past" (e.g., when she was part of a play where all children were given red wigs). In contrast, the other adverbial-clause-like interpretations are restricted to specific discourse or sentential contexts.

In Zobel (2017, 2018), I discuss Stump's formal account and propose a new analysis of the semantic variability of weak adjunct *as*-phrases.[3] In these papers, I focus mainly on how to adequately capture the temporal and conditional interpretations and argue that they arise indirectly via the interaction of a weak free adjunct with a temporal or modal operator (i.e., past tense in (1b) and *would* in (1c)). Since there is no operator that can be plausibly identified as the source of the causal interpretation, I set aside the details of how the causal-clause-like interpretation arises and adopt the suggestion in Jäger (2003) that the "causal link" responsible for this interpretation is the *discourse relation* EXPLANATION, which can be inferred to obtain between two independent utterances (see e.g. Asher and Lascarides, 2003).[4]

The main aim of this paper is to close this gap and to investigate the type of causal interpretation found with free adjuncts in unembedded declarative clauses and to present a proposal for how the underlying "causal link" arises that is compatible with my analysis of the semantic variability of weak adjunct *as*-phrases in Zobel (2017, 2018).[5] I propose that the free adjunct provides (part of) the speaker's evidence for asserting the truth-conditional content of the host clause. The "causal link" is inferred from general pragmatic requirements placed on the assertion act connected to the truth-conditional content of the host clause. Inferring this link is, furthermore, necessary since free adjuncts contribute presupposed propositional content that is not *lexically linked* to the truth-conditional content of the host clause.

My methodological aim is to defend an account for the causal interpretation that does not appeal to covert operators or a structural "discourse layer" with discourse-oriented functional heads. This does not mean that I have reasons to discard accounts that use these tools. The goal is merely to check how far an account without these additional assumptions can take us.

The paper is structured as follows. In Section 2, I review Stump's analysis of the "causal link" and his proposal for how it is to be captured. I show that Stump's main supporting data can be given an alternative analysis. Section 3 takes a closer look at the type of "causal link" found with free adjuncts and its information status by comparing causally interpreted free adjuncts to causal adverbial clauses. In Section 4, I present my own proposal for how the "causal link" arises. Based on the semantic proposal for weak adjunct *as*-phrases in Zobel (2017, 2018), I present a pragmatic account that connects the inference of the "causal link" to general pragmatic requirements connected to assertions. Section 5 concludes the paper.

[3]Note that not all *as*-phrases are weak adjuncts. Weak adjunct *as*-phrases form Class 4 *as*-phrases in the classification sketched in Zobel (2016).

[4]I put "causal link" in scare quotes throughout this paper because, as we will see in Section 3, the propositions contributed by the free adjunct and the main clause are not linked via a strict causal relation.

[5]The syntactic and semantic behavior of free adjuncts with adverbial-clause-like interpretations in embedded declarative clauses and other sentence types is exceedingly understudied, and an adequate discussion of these cases is beyond the scope of this paper.

2. Discussion of the analysis in Stump (1985)

Stump (1985) assumes that free adjuncts that are linked either causally, concessively, or temporally to the main clause introduce a free relational variable *L*. *L* is not part of the lexical material that makes up the free adjunct but is added to its basic semantic contribution via a type-shifting rule. Semantically, *L* is an unspecified propositional relation that links the propositional content of the free adjunct (underlined in (2)) to the propositional content *P* of the main clause.[6]

(2) $[\![\textit{as a child}]\!] = \lambda P.\lambda t.\mathscr{K}(L)(\underline{\exists t'[M(t,t') \text{ \& } \mathrm{AT}(t', \exists x^s[R(x^s,y^i) \text{ \& child'}(y^i)]])]})(P(t))$
(Zobel, 2018: 501)

For a sentence containing a free adjunct with this contribution to get its full interpretation, a value for *L* has to be inferred (e.g., a causal propositional relation).[7]

Stump assumes that content can be either contributed by a lexical item or inferred. Furthermore, he distinguishes two types of content: truth-conditional content and content that is purely inferred. Content that is contributed by lexical items will always be part of the truth-conditional content of the sentence, while content that is inferred can be either purely inferred or part of the truth-conditional content as the inferred value of a free variable. This means that one consequence of Stump's analysis in (2) is that the causal relation inferred for *L* becomes part of the truth-conditional content of the sentence and is subsequently part of what is asserted.

As support for this analysis, Stump presents (3) and (4), which he uses to compare the information status of the "causal links" found with free adjuncts, appositive relative clauses, and conjunctions. According to Stump, the possible combinations of A and B utterances show that the "causal link" found for appositive relative clauses and conjunctions is never part of what is asserted—in contrast to the "causal link" understood with free adjuncts.

(3) A: John, being an Englishman, is brave. (Stump, 1985: 22)
A': John, who is an Englishman, is brave.
A": John is an Englishman, and he is brave.

(4) B: No, that's not why he is brave.
B': Are you implying that John is brave because he is an Englishman?

Stump describes (3) and (4) as follows: the assertion in A can only be answered with B, while A' and A" can only be answered with B'. The answers in B and B' share that they both deny or call into question the "causal link" between being an Englishman and John's being brave. They differ with respect to whether truth-conditional content or inferred content is targeted; the utterance in B, which is a direct denial, putatively only targets truth-conditional content (i.e., asserted content), while the utterance in B' targets content that is purely inferred. Since B can be used as an answer to A, Stump concludes that the "causal link" is part of the asserted, truth-conditional content of A while any "causal link" that is understood for A' and A" is purely inferred. This supports Stump's choice to represent *L* on the truth-conditional level.

However, I do not agree with Stump's analysis of (3) and (4). Specifically, the observation that

[6] The formula in (2) is based on Stump's own proposal for *as* and has been derived using Stump's interpretation rules and type-shifting rules. For a more comprehensive summary of Stump's proposal, see Zobel (2018).

[7] In addition to a propositional relation, a temporal relation needs to be inferred to interpret the free variable M. M temporally orders the propositional content contributed by the free adjunct and the propositional content P.

A can be the target of a direct denial like B is not conclusive evidence that the "causal link" is part of the truth-conditional content of A. Recent work on the deniability of different types of content has shown that non-asserted content p can also be the target of direct denials of the form "No, $\neg p$". Cummins et al. (2013) investigate the deniability of presupposed content and find that, for instance, the presupposed content triggered by *quit* can be denied in this way:

(5) A: Did John quit smoking? (Cummins et al., 2013: 207)
B: No, he never used to smoke.

In (5), B's answer of the form "No, $\neg p$" directly denies the presupposed content p triggered by *quit* (i.e., John used to smoke). Hence, Stump's conclusion—that the possibility of directly denying the "causal link" is a clear indication that it is asserted—is not warranted.

Furthermore, we can construct felicitous dialogues in which a "causal link" that is inferred to hold between two utterances by different speakers is denied directly, as in (6).

(6) A: John saved a kitten from drowning. He is really brave!
B: Well, he is an Englishman.
C: No, that's not why he is brave. His mother is a fire fighter.

For (6), a "causal link" is understood to hold between B's utterance and A's last sentence. However, none of the lexical elements in B's utterance in (6) plausibly contributes a silent relational variable.[8] Hence, C's subsequent denial arguably does not target anything that is part of the truth-conditional content of B's utterance. This again shows that the "causal link" targeted by B in (4) is not necessarily part of the truth-conditional content of A in (3).

Example (7) instead suggests that direct denial of an inferred "causal link" is only felicitous if that link is clearly the only connection that the previous speaker intended to communicate.

(7) [*Context:* A and B talk about John, who recently celebrated his 60th birthday.]
A: By the way: as a student, John didn't own a car.
B: No, that's not why he didn't own a car.
B': Are you implying that John didn't own a car back then because he was a student?

In (7), the *as*-phrase in A's utterance can be taken to contribute either only a temporal interval or also a reason for why John did not own a car. In this context, the answer in B seems odd since it is not clear that A intended to communicate more than the temporal link between John's being a student and his not-owning a car. Here, the answer in B' seems more appropriate.

In sum, Stump's motivation for making the "causal link" part of the truth-conditional content via a free variable L that is contributed by the free adjunct does not withstand closer scrutiny.

3. The "causal link" and its information status

3.1. The type of relation expressed by the "causal link"

It is well-known that lexical items that are traditionally called "causal connectors" do not always express a strict causal connection between the contents that they relate to each other. A

[8]The discourse marker *well* signals that B's utterance disagrees with A's expectations (see e.g., Heritage, 2018). That is, A's utterance suggests that John's bravery is surprising or exceptional, while for B, it is an expected result of his being an Englishman. Hence, the "causal link" that is understood between A's and B's utterances cannot be attributed to *well*.

strict causal relation holds between two contents if one names a cause and the second the effect of that cause. Lewis (1973: 556) characterizes a cause as an "indispensable part of the total situation that is followed by the effect in accordance with a law".[9]

The relation contributed by the "causal link" found with free adjuncts is not a strict causal relation. To see this, it is instructive to consider the range of "causal relations" that can be expressed by causal adverbial clauses. Taking up results from the previous literature (e.g., Sæbø, 1991), Charnavel (2017b) distinguishes three types of causal adverbial clauses: *eventive causal clauses*, *evidential causal clauses*, and *speech act causal clauses*, illustrated in (8).

(8) a. Liz left because she was tired. (Charnavel, 2017b: 148)
 b. Liz (must have) left, since her coat is gone.
 c. Since you know everything, did Liz leave?

Eventive causal clauses, like the *because*-clause in (8a), contribute the cause of the matrix eventuality; (8a) conveys that Liz's being tired caused her to leave.[10] Evidential causal clauses, like the *since*-clause in (8b), provide evidence for the truth of the matrix proposition; the causal clause in (8b) provides the speaker's grounds for why they think that Liz left (i.e., her coat is gone). And speech act causal clauses, like the *since*-clause in (8c), name the speaker's motivation for performing the speech act; the speaker's asking the question in (8c) is motivated by the content of the *since*-clause (i.e., the addressee knows everything).

The connectors *because* and *since* differ with respect to which type of causal clause they can introduce: *because* can introduce eventive or evidential causal clauses while *since* can introduce evidential or speech act causal clauses.[11]

At first glance, the "causal link" found with free adjuncts seems to mirror the relations found in both eventive and evidential causal clauses, consider (9); only for speech act causal clauses, I was not able to find an attested example involving a free adjunct and a declarative clause.

(9) a. **As a mother**, I empathize with the fear of losing a child.
 (COCA: Saturday Evening Post, 2014)
 b. **Being wise**, their gifts were no doubt wise ones. (COCA: Girls' Life Vol. 4, 2003)

Example (9a) could be taken to claim that the speaker's being a mother causes her to empathize with the fear of losing a child. In (9b), on the other hand, the free adjunct arguably presents the evidence for why the speaker is confident in claiming that the gifts were wise (which is supported by the added *no doubt*).

The characterization of (9), however, involves only best guesses about what these examples convey. What makes it especially difficult to determine whether an eventive causal relation or

[9]Causal connectors that express strict causal relations can be further distinguished by whether they express direct or indirect causation. See Maienborn and Herdtfelder (2017) for a discussion of the causal use of German *von*-PPs and other prepositional expressions and their differences in this respect.
[10]It is debatable whether Liz's being tired is conceptualized as a cause of her leaving in the strict sense. Regarding the possible interpretations of *because*, Solstad (2009) not only shows that *because*-clauses can express true causal relations, but also that they can provide an agent's reason for performing an action. That is, (8a) can be taken to express that Liz's reason for leaving was her tiredness. Both potential interpretations fall into Charnavel's class of eventive causal clauses since neither can be expressed using *since*.
[11]A comparable split can also be observed in other languages, see Sæbø (1991: 624).

an evidential causal relation is expressed, is that causes can, of course, serve as evidence. For instance, if a speaker believes that it has rained, they can use this as inferential evidence for claiming that the streets are wet. Hence, it is practically impossible to determine the possible types of "causal link" based on purely conceptual considerations. The strategy adopted in the remainder of this subsection is to check whether causally interpreted free adjuncts share some of the properties of causal adverbial clauses that correlate with specific interpretations.

I will employ two contexts in which eventive causal clauses and evidential causal clauses differ in order to show that causally interpreted free adjuncts pattern with evidential causal clauses. The first context are answers to *why*-questions, for which Charnavel (2017a: 45) observes that they can only be answered using eventive causal clauses, see (10).

(10) A: Why has Liz left? (Charnavel, 2017a: 45)
B: She left because she was tired.
B': #She left, since her coat is gone.

In (10), only the answer with an eventive *because*-clause is felicitous; answering A's *why*-question with an evidential *since*-clause results in oddness. This is also the case if A's question is changed to explicitly ask for B's evidence (i.e., *How do you know that Liz has left?*).[12] With respect to answering *why*-questions, free adjuncts pattern with evidential *since*-clauses, compare (10) to (11).

(11) A: Why does Liz empathize with this fear?
B: She empathizes with this fear because she is a mother.
B': #**As a mother**, <u>she</u> empathizes with this fear.

The second context that distinguishes eventive and evidential causal clauses involves the focus particle *only*. Charnavel (2017a: 47–48) reports the observation that *only*, which conventionally associates with focused material, can associate with eventive *because*-clauses but not with evidential *since*-clauses. This is illustrated in (12).

(12) a. Liz has only left because she was tired. (Charnavel, 2017a: 48)
(can mean: the only reason why Liz has left is her tiredness)
b. #Liz has only left since her coat is not on the rack. (Charnavel, 2017a: 47)
(intended: the only piece of evidence indicating that Liz has left is the absence of her coat on the rack)

The sentence in (12b) cannot express the intended paraphrase, in which *only* is made to target the "causal relation" contributed by the *since*-clause. The only available reading for (12b) is that the absence of Liz's coat on the rack constitutes the speaker's evidence for the claim that Liz only left (and did not do anything else).

The behavior of the *since*-clause in (12b) is again mirrored by free adjuncts. Neither of the sentences in (13) can express that Liz's being a mother is the speaker's only evidence for the claim that she empathizes with this fear.

(13) a. **As a mother**, <u>Liz</u> only empathizes with this fear.
b. <u>Liz</u> only empathizes with this fear, **as a mother**.

[12] Note that this question can be answered using an eventive *because*-clause that targets an explicit attitude verb: *I believe that she has left because her coat is gone*.

The only available reading for the two sentences—if the *as*-phrase is read as a weak free adjunct[13]—is that Liz's being a mother is the speaker's evidence for the claim that Liz only empathizes with this fear (and, e.g., with nothing else).

Charnavel (2017b: 149–151) attributes the interpretational and pragmatic differences between eventive and evidential causal clauses to their syntactic positions. That is, the two causal relations are restricted to specific syntactic attachment points: eventive causal clauses attach low in the syntactic structure and are part of the VP-layer while evidential causal clauses attach higher in the functional structure and are part of the left periphery.[14] This high syntactic attachment point of evidential *since*-clauses captures their inability to be part of the focus of their host sentences (i.e., they cannot provide the answer to a constituent question or be the target of *only*). So, given that free adjuncts with a "causal link" pattern with evidential *since*-clauses, it is plausible to assume that they are attached at least as high as evidential *since*-clauses.

In Zobel (2018), I argue that the possible interpretations of weak free adjuncts are connected to their syntactic attachment points.[15] Hence, if we assume that the syntactic attachment point of an adjunct determines which type of causal relation can be expressed, we can conclude from the above that a plausible candidate for the "causal link" is an evidential explanation relation comparable to the relation contributed by evidential *since*-clauses. In particular, I propose that a sentence containing a causally interpreted free adjunct presents the speaker's epistemic grounds for their claim (i.e., a/the reason for why the speaker believes the main clause proposition).

(9a) **As a mother**, I empathize with the fear of losing a child.

That is, for (9a), I assume that, by mentioning that she is a mother, the speaker provides explicit explanatory/supporting evidence for her claim that she empathizes with this particular fear.

3.2. The information status of the "causal link"

In Section 2, I discussed Stump's examples (3) and (4), which supposedly show that the "causal link" is part of what is asserted, and demonstrated that this conclusion is not warranted. In this subsection, I again address the information status of the "causal link". I show that there are good reasons to assume that the "causal link" is not part of the truth-conditional content of the host sentence of the free adjunct and, further, that the link is not contributed by the free adjunct.

For evidential *since*-clauses, Charnavel (2017a) concludes that the causal relation and the propositional content of these clauses are not-at-issue. This conclusion is based on examples (10) and (12) and the behavior of *since*-clauses in connection with answers of the form "Yes, but, $\neg p$", which express partial assent, see (14) (cf. the tests in Tonhauser, 2012).

[13]If the *as*-phrase in example (13b) is not separated from the main clause by comma-intonation, it is interpreted as a role *as*-phrase (i.e., Class 3 in Zobel, 2016). In this interpretation, the *as*-phrase picks out a role of Liz's, her mother-role, and restricts the application of the main clause predicate to this role. In this case, the *as*-phrase is part of the focus and can, hence, be the target of *only*. In this alternative interpretation, (13b) states that Liz empathizes with this fear only in her role as a mother (but not in any other role).

[14]Speech act causal clauses are assumed to be highest among causal adverbial clauses and to modify a Speech Act Phrase in the high left periphery.

[15]That attachment height correlates with interpretation also for other non-clausal adjuncts has been observed, for instance, in Maienborn (2001) for locative PPs.

(14) A: Liz has left, since her coat is not on the rack. (Charnavel, 2017a: 46)
B: Yes, true, but her coat is in fact on the rack.
B': Yes, true, but in fact the absence of her coat does not prove anything...
B": #Yes, true, but in fact, she has not left.

In (14), the answers in B and B' assent to the asserted content of A's utterance (i.e., Liz left), but deny the propositional content of the *since*-clause (B) and its status as valid evidence (B'); both answers are pragmatically acceptable. However, the analogous answer in B" is pragmatically odd, since the speaker first assents to and then denies the same truth-conditional content.

Examples (11), (13), and (15) support analogous conclusions for the content contributed by the free adjunct and the "causal link": neither is part of the asserted, truth-conditional content.

(15) A: **As a mother**, Liz empathizes with this fear.
B: Yes, true, but she is in fact not a mother. (She never had kids!).
B': Yes, true, but in fact being a mother does not explain her empathy.
B": #Yes, true, but Liz does not empathize with this fear.

So, unlike the direct-denial diagnostic used by Stump (see Section 2), the partial-assent diagnostic in (15) teases apart the asserted proposition from other types of content conveyed by A's utterance.[16]

The discussion so far is compatible with the assumption that causally interpreted free adjuncts contribute both their propositional content, as well as the "causal link" as not-at-issue content. However, the data does not force us to assume that the "causal link" is contributed by the free adjunct; compare (16) to (17) (see also (6)).

(16) **As a doctor**, Eric had an instinctive dislike for tattoos. (COCA: Analog SciFi & Fact, 2012)

(17) A: Eric dislikes tattoos.
B: Well, he is a doctor.

For both (16) and (17), Eric's being a doctor is understood as an explanation for why Eric dislikes tattoos. For (17), just as in (6), this relation cannot plausibly be attributed to any given lexical element. Hence, explanation relations between two propositions can be purely inferred (e.g., EXPLANATION in Asher and Lascarides, 2003).[17]

Furthermore, the assumption that the "causal link" is not contributed by the free adjunct allows for a more parsimonious account of the different interpretations observed for weak free adjuncts. If we were to assume that *as a child* in (18a) contributes the "causal link" itself, we would expect the causal interpretation to be understood whenever the *as*-phrase occurs.

[16] Note that there seem to be different direct-denial tests with distinct effects. Native speaker intuitions about well-formedness and what B denies in Stump's dialogue change if B just answers "No, that's not true", as in (i).
(i) A: John, being an Englishman, is brave.
B: No, that's not true.
Here, native speakers report that B's denial can only target the truth-conditional content; that is, B denies that John is brave. This suggests that denials of the form "No, $\neg p$" are more permissive regarding the information status of p, while *No, that's not true* seems to only target the asserted content.
[17] Crucially, I do not wish to suggest that the relations in (16) and (17) are the same and/or that they are inferred in the same way. As I argue in Section 4, the "causal link" understood in (16) arises for *as a doctor* because specific factors coincide, which are not observed for (17).

(18) a. **As a child**, Jerrie is entirely dependent on adults for survival.
b. **As a child**, Jerrie had red hair.

Example (18b) shows that for temporally interpreted weak free adjuncts, the causal interpretation does not necessarily arise if it is pragmatically implausible (i.e., the speaker does not suggest that Jerrie's child status explains why she had red hair back then). This optionality forces us to either assume an ambiguity for weak free adjuncts or to discard the assumption that the free adjunct contributes a "causal link" conventionally. I pursue the second option.

In sum, this section provided motivating evidence that the "causal link" found with free adjuncts is semantically close to the relation expressed by evidential causal clauses. Furthermore, unlike for causal adverbial clauses, I take this causal relation to be fully inferred; that is, the "causal link" is not contributed by the free adjunct.

4. A new proposal for how the "causal link" arises

4.1. Background: an analysis of weak adjunct *as*-phrases

A central role in my proposal, which I will present in Section 4.2, is played by the semantic properties of the propositional content contributed by the free adjunct, and how that content combines with the main clause proposition. To make this discussion more concrete, I first introduce the formal analysis of weak adjunct *as*-phrases proposed in Zobel (2017, 2018).

Even though *as*-phrases are weak adjuncts and, hence, show the full range of possible interpretations introduced in (1), the causal interpretation can be investigated reliably if the data is restricted to a specific class of sentential contexts: episodic, present-oriented sentences. In this type of sentence, *as*-phrases show a robust preference for a causal interpretation. In the same sentential context, verb-based free adjuncts sometimes express temporary properties of their associated object that are purely co-temporal to the circumstances described by the main clause (i.e., *attendant circumstances*), as illustrated in (19).[18]

(19) **Looking nervous**, she is carrying her belongings in a bundle.
(COCA: Literary Cavalcade 50, 1998)

In (19), *looking nervous* is understood to hold co-temporally to the main clause eventuality without temporally restricting that eventuality, and the two propositions denoted by the free adjunct and the main clause are not linked causally, concessively, or conditionally.[19] For weak

[18]A second advantage of *as*-phrases is that, in contrast to verb-based free adjuncts, they do not come with their own temporal/aspectual content. The participial forms in verb-based free adjuncts have an impact on the relative temporal ordering of the eventuality described by the main verb and the free adjunct (see Stump, 1985: Ch. 3-4).

(i) a. **Spying on his neighbors**, Peter saw Mary enter the house. (co-temporal)
b. **Taken in the prescribed dosage**, it would work better. (sequential)
c. **Having seen an accident ahead**, I stopped my car. (sequential)

In contrast, *as*-phrase content is always interpreted to be co-temporal to the main clause content.

[19]The main contrast between free adjuncts that contribute attendant circumstances and temporally interpreted weak free adjuncts lies in the fact that the latter temporally locate the main clause eventuality while the former do not, see (i) (repeats (18b)).

(i) **As a child**, Jerrie had red hair.

The *as*-phrase in (i) provides the reference time relative to which the eventuality described in the main clause is located; that is, *as a child* locates Jerrie's having red hair in a past temporal interval at which she was a child, see Zobel (2017, 2018).

adjunct *as*-phrases, this interpretation is unavailable, see (20).

(20) #**As a cat owner**, Peter is reading the newspaper.
(intended: Peter is a cat owner and is reading the newspaper.)

The only other interpretation that is observed for weak adjunct *as*-phrases in episodic, present-oriented sentences is a concessive interpretation. This interpretation, however, seems to be restricted to *surprise contexts* like the one in (21a).

(21) a. Peter really surprised me. **As a cat lover**, he likes his neighbor's dogs.
b. **As a cat lover**, he likes his neighbor's dogs.

After the first sentence in (21a), the addressee knows to expect something unexpected or unusual. In the second sentence, the speaker ascribes two properties to Peter, and given the surprise context, the combination of these two properties is understood to be surprising (for the speaker), which supports a "concessive link" between the *as*-phrase content and the main clause content. If the contextual support that drives the concessive interpretation is missing—assume that (21b) is uttered out-of-the-blue, the default interpretation for the link between the *as*-phrase proposition and the main clause proposition is the causal interpretation.

I adopt the semantic analysis for weak adjunct *as*-phrases in Zobel (2017). The core of this analysis is that weak adjunct *as*-phrases are propositional modifiers (type $\langle\langle i,st\rangle,\langle i,st\rangle\rangle$) that contribute mainly not-at-issue content, see (22).

(22) $[\![as\ [\mathrm{PRO}_c\ [a\ \mathrm{NP}]]]\!]^{g,w_0,t_0} = \lambda q_{\langle i,st\rangle}.\lambda t'.\lambda w' : [\![\mathrm{NP}]\!]^{g,w_0,t_0}(g(c))(t')(w') = 1.\ q(t')(w')$

In the analysis in Zobel (2017), weak adjunct *as*-phrases contain a Small Clause that is formed from a non-obligatorily-controlled PRO and an indefinite DP. The non-obligatorily-controlled PRO is interpreted contextually via the variable assignment g as the associated individual (i.e., $g(c)$), and the indefinite DP contributes a property of individuals, which is applied to $g(c)$. The main contribution of the *as*-phrase to its modified proposition q is propositional not-at-issue content:[20] the associated individual $g(c)$ has the property contributed by the indefinite DP at time t' in world w'.

Regarding the type of not-at-issue content, the analysis in (22) makes the more specific claim that weak adjunct *as*-phrases contribute presupposed content.[21] That this assumption is justified is shown in (23).

(23) a. Peter has three cats. #And, he, **who is a cat owner**, understands my cat troubles.
b. Peter has three cats. And, **as a cat owner**, he understands my cat troubles.

Example (23) contrasts the behavior of the propositional content contributed by an appositive relative clause to that contributed by a weak adjunct *as*-phrase. Example (23a) illustrates that using an appositive relative clause results in oddness if its content has been established previously (see Potts, 2011). In contrast, the use of the weak adjunct *as*-phrase in (23b) is completely

[20] The not-at-issueness of this content has been shown as part of the comparison with *since*-clauses in Section 3.

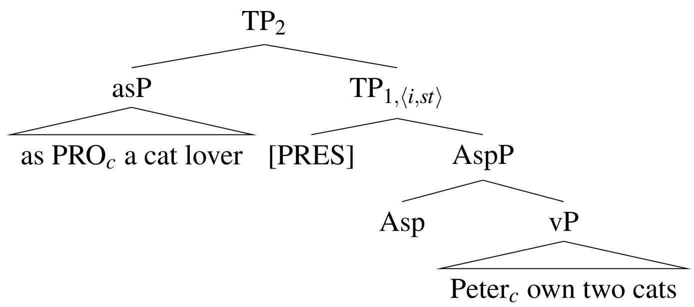
[21] Vera Hohaus (p.c.) suggests that the *as*-phrase might not contribute presupposed content itself, and that the propositional *as*-phrase content might instead be "presuppositionalized" via a covert operator (see Hohaus's FRAME-operator in Hohaus, 2015). Since this question is orthogonal to the question of how the "causal link" arises, I will leave it to future research.

well-formed in exactly the same context, which is expected behavior for presupposed content (see Beaver and Geurts, 2011).

The formal proposal in (22) can directly account for the temporal and the conditional interpretations of weak adjunct *as*-phrases. Depending on which position on the functional spine of the main clause the *as*-phrase adjoins to (see Zobel, 2018), the temporal variable t' and the world variable w' in (22) are identified with different time and world variables involved in the interpretation of the main clause: the temporal interpretation arises through identification of t' with the reference time of the main clause, and the conditional interpretation arises through binding of w' by a modal quantifier in the main clause (see Zobel, 2017 for details).

A causally interpreted *as*-phrase, I argue in Zobel (2018), occupies the highest adjunct position in the functional spine. This means that *as a cat lover* in (24) adjoins to TP, at a point where the full main clause proposition has been formed, see (25).

(24) **As a cat lover**, Peter owns two cats.

(25)


For reasons of simplicity, I ignore the temporal and aspectual information found in the main clause and assume that TP_1 in the tree above denotes the proposition in (26). The contribution of *as a cat lover* is provided in (27).

(26) $\lambda t.\lambda w.$ owns-two-cats(Peter)$(t)(w)$ (TP_1)

(27) $\lambda q_{\langle i,st\rangle}.\lambda t'.\lambda w'$: cat-lover$(g(c))(t')(w') = 1.\ q(t')(w')$ (asP)

Combining the semantic contribution of the *as*-phrase in (27) with the matrix proposition in (26) results in a proposition where the world and time of evaluation of the presupposed content and the truth-conditional content are linked, see (28).

(28) $\lambda t'.\lambda w'$: cat-lover(Peter)$(t')(w') = 1.$ owns-two-cats(Peter)$(t')(w')$ (TP_2)

Let us assume that (24) is uttered at t_0 in w_0. As a result, (28) is evaluated with respect to t_0 and w_0, which results in the truth-conditions in (29).

(29) *As a cat lover, Peter owns two cats* is true in w_0 at t_0 iff owns-two-cats(Peter)$(t_0)(w_0)$
[*provided that:* cat-lover(Peter)$(t_0)(w_0) = 1$]

The "causal link" that is intuitively understood for (24) is crucially not part of either the truth-conditional content or the presupposed content of this sentence, see (28). This is exactly as desired given the results of Section 2 and 3; the "causal link" is not contributed by the free adjunct but is inferred.

4.2. The origin of the causal interpretation

The compositional analysis discussed in the previous subsection outputs two propositional contents for sentences like (24), the content contributed by the free adjunct p and the main clause content q. The results of Sections 3.2 and 4.1 support the view that the two contents have different information status: p is presupposed while q is asserted. I propose that the "causal link" between p and q arises because the content contributed by the free adjunct p is a specific kind of presupposed content that is not *lexically linked* to the main clause content q. It is as a result of this lack of a lexical link, that a link between p and q has to be inferred when interpreting the sentence. That it is a "causal link" of the type described in 4.2 is the result of the information status of p and q.

Before spelling this idea out in more detail, I briefly discuss some counter-examples against proposals that identify *world knowledge regularities* as the source of the "causal link". More concretely, I argue against the idea that during the interpretation of utterances like (24), the interpreter accesses their body of knowledge about individuals who have the property denoted by the complement of *as* and checks for a regularity that links the *as*-phrase content to the main clause content (e.g., "cat lovers own cats" for (24)). If such a regularity is found, the interpretation of the sentence can be enriched with a "causal link" between the *as*-phrase content and the main clause content. Proposals based on this idea make inadequate predictions. First, they predict no "causal link" to arise with pseudo-word sentences. This is not borne out; contrary to what we would expect, we understand the *as*-phrase content in (30) to provide an explanation for the main clause content even though there is no matching world-knowledge regularity.

(30) **As a bleep**, <u>Peter</u> is blooping.

Second, these proposals predict no "causal link" to be understood if there is a world knowledge regularity that links the property denoted by the complement of *as* to the negation of the main clause predicate. Let us, for instance, assume that, in general, cat owners like cats; hence, "cat owners do not like cats" is not a valid world knowledge regularity. As a result, no "causal link" should be inferable for (31), contrary to fact.

(31) **As a cat owner**, <u>Emily</u> dislikes cats.

Examples (30) and (31) suggest that for the interpreter, the connection between the "causal link" and potential world knowledge regularities is reversed. For instance, being presented with (30) prompts the interpreter to entertain the new world knowledge regularity that bleeps bloop. For the speaker, their beliefs about valid world knowledge regularities will motivate their utterances; a speaker who utters (30) can be taken to believe that bleeps bloop since they take Peter's being a bleep to support the claim that he is blooping (see Section 3). But, while world knowledge regularities may enter into the reasoning processes of the speaker and the interpreter in connection with the uttered content, they are not the source of the "causal link".

Let me now address my own proposal for how interpreters come to understand that the speaker takes the content of the free adjunct p to explain/support their claim that the main clause content q holds. This explanatory connection is inferred as a result of two properties of p: (i) it is presuppositional and (ii) it is not *lexically linked* to the main clause content.

The importance of the presuppositionality of p is best seen in comparison to the behavior of appositive content. Like free adjuncts, appositive relative clauses contribute propositional not-at-issue content about an individual denoted by a DP in the main clause—but arguably one of a different type (see (23) in Section 4.1; Potts, 2011). While it is possible to understand a causal relation between appositive content and the main clause content (see Section 2), this interpretation is not the default and rather sensitive to world knowledge. Compare the behavior of the appositive relative clauses in (32) to that of the corresponding *as*-phrases above.[22]

(32) a. Peter, **who is a cat lover**, owns two cats.
b. Peter, **who is a bleep**, is blooping.
c. Emily, **who is a cat owner**, dislikes cats.

For all three examples in (32), it is possible to understand the appositive content and the main clause content to hold conjointly without inferring any additional relation to hold between them. The preferred interpretations of (32a) and (32c), however, involve a causal and concessive relation between the appositive and main clause content, respectively. For (32b), any such additional relation is much harder to understand. This contrast between (32a) and (32c) vs. (32b) suggests that the additional relations arise as a result of the specific combinations of appositive content, main clause content, and world knowledge.[23] Recall that we observe no parallel contrast for the corresponding *as*-phrases.

In addition, the discourse context readily affects the interpretation of appositive content. In the context of A's prompt in (33), the appositive relative clause in B is understood to simply provide additional information on Paul; no causal or concessive relation is understood.

(33) A: You always mention this "Paul"... tell me something about him!
B: Paul, **who is a linguist from Tübingen**, is tall and works on ellipsis.
B': **As a linguist from Tübingen**, Paul is tall and works on ellipsis.

In exactly the same context, the *as*-phrase in B' cannot be understood as providing only another piece of information about Paul. B' invariably communicates that Paul's being tall and working on ellipsis can be explained by his being a linguist from Tübingen. Hence, the type of not-at-issue content has an impact on the default status of the causal interpretation.

The observation that a "causal link" is inferred by default is also connected to the specific type of presuppositionality of the content of the free adjunct p: p and the main clause content q are not *lexically linked*. The presupposed contents that are commonly discussed in the literature are all lexically linked to the content of their containing clause (see e.g. Beaver and Geurts, 2011 for a list). This link is the result of the respective triggers, which can be classified based on the specifics of the link that they introduce. Following Zeevat (1992: 397–399), (at least) three classes of presupposition triggers can be distinguished: *resolution triggers*, *lexical triggers*, and

[22] Analogous observations to those in (32) and (33) can be made for appositive nominals, like *a cat lover* in *Peter, a cat lover, owns two cats*.

[23] The observation that we seemingly automatically understand additional relations between propositions if they are plausible is partial motivation for the pragmatic constraint *Maximize Discourse Coherence* in Asher and Lascarides (2003) (my emphasis).

(i) *Maximize Discourse Coherence:* Maximizing coherence amounts to prefer discourse structures with the smallest number of nodes, the fewest semantic and pragmatic clashes, *the largest number of rhetorical relations*, and the fewest number of underspecifications. (Asher and Lascarides, 2003: 234) *bookkeeping triggers*, which are illustrated in (34).[24]

(34) a. The King of France is a smoker. (resolution trigger)
b. Mary stopped smoking. (lexical trigger)
c. Peter is also a smoker. (bookkeeping trigger)

For resolution triggers (e.g., definite descriptions), the presupposition is needed to determine their contribution to the truth-conditional content of their containing clause. For lexical triggers (e.g., factive and aspectual verbs), the presupposition constitutes a condition on the appropriate use of the trigger; only if the presupposed content is true, it is appropriate to add the truth-conditional contribution of these triggers to the containing clause. And lastly, for bookkeeping triggers (e.g., *too*, *also*), the trigger relates the content of the containing clause to previously established content in order to signal their distinctness. So, for all three classes, the relation between the presupposed content and the content of the containing clause is fixed by the trigger.

The presupposed content of free adjuncts cannot be related to any of these three classes, since its presuppositionality is not induced by any element in the containing clause (i.e., there is no explicit trigger). This can be seen as the main difference between free adjuncts and sentential complements of factive verbs. For both types of expressions, the propositional content that is presupposed to be true is contributed by explicit lexical material that is part of the utterance, as illustrated in (35).

(35) a. Mary knows **that Peter is a cat owner**. (presupposes: Peter is a cat owner.)
b. **As a cat owner**, Peter loves cats. (presupposes: Peter is a cat owner.)

The presuppositional status of the *that*-clause in (35a) can be plausibly attributed to the factive verb *know*, which takes the content of the clause as its argument. No comparable lexical relation can be determined for the propositional status of the *as*-phrase in (35b).[25]

Pragmatically, presupposed content that is unlinked to the remainder of the utterance is problematic. If presupposed content *p* were to remain unlinked, the interlocutors would be left to wonder why the speaker chose to communicate *p* in the first place given that they already consider *p* to be established. This, I suggest, is the pragmatic motivation for inferring the "causal link" for free adjuncts: it fills the gap created by the missing lexical link.

This is supported by the fact that presupposed content that is lexically linked to the main clause content is never understood with a "causal link". This is illustrated for the sentential complement of *know* and the presupposition of *stop* in (36) and (37).

(36) Mary knows that Peter owns cats. (presupposes: Peter owns cats.)
Cannot mean: Since Peter owns cats, Mary knows that he owns cats.

(37) Mary stopped smoking. (presupposes: Mary used to smoke.)
Cannot mean: Since Mary used to smoke, she stopped smoking.

[24]The term "bookkeeping triggers" is mine. Zeevat does not officially name triggers of this class but describes them as "playing a role in the bookkeeping involved in storing information by humans" (Zeevat, 1992: 399).

[25]The lack of an independent trigger for free adjuncts would be problematic if we were to assume that all presuppositions need to be triggered. In that case, we could assume that free adjuncts become presuppositional through a covert operator that, however, does not link the presupposed content to the truth-conditional content (e.g., FRAME, Hohaus, 2015). I will not pursue this option in this paper.

The need for a link between presupposed content and asserted content does not explain why it is a "causal link" that is inferred for free adjuncts. The specific flavor of "causal link" is the result of linking the presupposed content to the assertion as a whole. In particular, it is the result of relating it to the act of asserting the truth-conditional content of the main clause.

This assumption is supported by the high syntactic attachment point of causally interpreted free adjuncts. The comparison between free adjuncts and *since*-clauses in Section 3.1 suggested that both attach to a position above TP, which is reflected in the semantic proposal in Section 4.1, see the tree in (25). The high attachment point above TP—to a position where the main clause proposition has been fully formed—suggests that the content contributed by the free adjunct is related to a discourse-oriented aspect of the utterance. Cross-linguistically, structurally high positions are occupied by lexical material that conveys a speaker attitude or specifies how the propositional content is to be integrated in the current common ground between the interlocutors (see Stalnaker, 2002). For instance, speaker-oriented and other discourse-related adverbials in German and English attach high in the syntactic structure (see e.g., the overview in Maienborn and Schäfer, 2011), and also clause typing, which is connected to the primary speech act that is performed by uttering a sentence, involves structurally high positions (see e.g., Sadock and Zwicky, 1985 and much subsequent work).

The discourse-oriented aspect of the utterance to which the free adjunct relates is the assertion made by the speaker. By asserting a propositional content q, the speaker enters a commitment with respect to q and, furthermore, sets q up to become part of the common ground and, thus, part of the commitments of all interlocutors (see e.g., Farkas and Bruce, 2010). In a standard discourse where the main goal is exchange of information, an interlocutor is taken to believe q on the basis of such a commitment (see Pagin, 2014). Hence, co-operative behavior dictates that speakers should only assert what they believe to be true and for which they have adequate evidence (cf. the Gricean *Maxim of Quality*, Grice, 1989).[26] The presuppositional content p contributed by a free adjunct (i.e., content that is presented by the speaker as established) is inferred to explicitly provide the speaker's supporting evidence for their claim that q is true.

The similarity between evidential *since*-clauses and causally interpreted free adjuncts (see Section 3.1), hence, lies in the assumption that both provide evidence for the truth of the main clause proposition. For both expressions, their propositional content can be taken to explain why the speaker assumes the main clause proposition to hold, see (38).

(38) a. **Since Sam is a playwright**, he is drawn to the philosophical.
b. **As a playwright**, <u>Sam</u> is drawn to the philosophical.

The two expressions differ in how the propositional content is related to the main clause proposition. While *since* contributes this relation conventionally, a comparable link has to be inferred for free adjuncts in connection with the assertion act.

Let me conclude this section by briefly addressing the "concessive link" that is available for free adjuncts in surprise-contexts, see (39).

(39) Peter really surprised me. **As a bleep**, <u>he</u> is blooping.
(≈ Even though Peter is a bleep, he is blooping.)

[26] The two submaxims of the Gricean *Maxim of Quality* are also found in Searle's (1969) sincerity condition and first preparatory condition for assertions, see the discussion in Pagin (2014).

In surprise-contexts, the "causal link", which is the default for syntactically high free adjunct *as*-phrases in episodic, present-oriented sentences, loses its default status. This happens even with pseudo-word sentences like (39), for which it is impossible to appeal to world knowledge effects. While the context-dependent disappearance of the default "causal link" supports an inferential account, it also raises new questions: How does the concessive interpretation in surprise-contexts arise? And how do the surprise-contexts block the causal interpretation?

As suggested in Section 4.1, a surprise-context signals to the addressee that they can expect something unexpected. Hence, it becomes highly implausible in these contexts that the free adjunct and the main clause are linked via a "causal link", which conveys a regularity. So, the blocking of the "causal link" can be plausibly linked to the type of context.

It is less clear to me how to account for the "concessive link". Like the "causal link", the "concessive link" does not seem to arise from an interaction between the presuppositional content contributed by the free adjunct and an operator in the same clause (i.e., the "concessive link" seems to be fully inferred). However, the inferential account proposed for the "causal link" cannot be adapted straightforwardly to the "concessive link". A general inferential account based on pragmatic principles of discourse is in conflict with the restricted contexts of occurrence. Therefore, I would like to suggest that surprise-contexts, as in (39), involve embedding of the sentence containing the free adjunct under a surprise-predicate. This is supported by the intuition that the second sentence in (39) describes which of Peter's properties was surprising to the speaker. If such an embedding can indeed by assumed, the "concessive link" could be analyzed as arising from an interaction with the attitude: as the speaker's doxastic grounds for their surprise.[27] Example (39), for instance, would then convey that the speaker is surprised that Peter is blooping based on their belief that Peter is a bleep. A detailed investigation of the "concessive link" and a thorough evaluation of this idea, hence, necessitates a clearer picture of the behavior of free adjuncts in embedded contexts and their interaction with attitude predicates. I leave this task to future work.

5. Conclusion

In this paper, I took a closer look at the causal-clause-like interpretation of free adjuncts and how it arises. I started out by calling into question Stump's assumption that the "causal link" is part of the asserted, truth-conditional content that is contributed by a sentence hosting a causally interpreted free adjunct. The subsequent comparison with *since*-clauses showed clear parallels between causally interpreted free adjuncts and evidential *since*-clauses: neither the propositional content contributed by free adjuncts nor the "causal link" are asserted. I presented evidence supporting the conclusion that the propositional content of the free adjunct is presuppositional and that the "causal link" is pragmatically inferred. Based on a concrete proposal for the compositional semantics of weak adjunct *as*-phrases, I proposed that the "causal link" arises because the presupposed propositional content of free adjuncts is not *lexically linked* to the main clause proposition. Assuming that presupposed content needs to be linked to the asserted content in one way or another, I suggested that the "causal link" is inferred by connecting the presupposed content to general requirements of the assertion act.

As stated in the introduction, the proposal put forth in this paper constitutes an attempt to account for the causal interpretation of free adjuncts without appealing to covert operators or

[27] I thank Nina Haslinger (p.c.) for helpful discussion on these cases.

structural positions above TP that form a syntactic "discourse layer" (cf. the different structural proposals in Krifka, 2018; Speas and Tenny, 2003; and Wiltschko, 2014). I am aware that my suggestion for why the link that we infer is a "causal link" in Section 4.2 can be considered too weak to adequately capture its default status. At the moment, I do not see how my proposal can be improved, and I do not want to exclude that future work will reveal that the additional assumption of covert operators and/or a syntactic discourse layer is, in fact, necessary.

The most promising direction for future research seems to me to be a detailed investigation of the behavior of free adjuncts in embedded contexts, particularly under attitude predicates, and in non-declarative sentences. The latter context is the strongest test case to check the core assumption of the main proposal that the "causal link" is connected to the assertion act.

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